SCIENTIFIC AMERICAN

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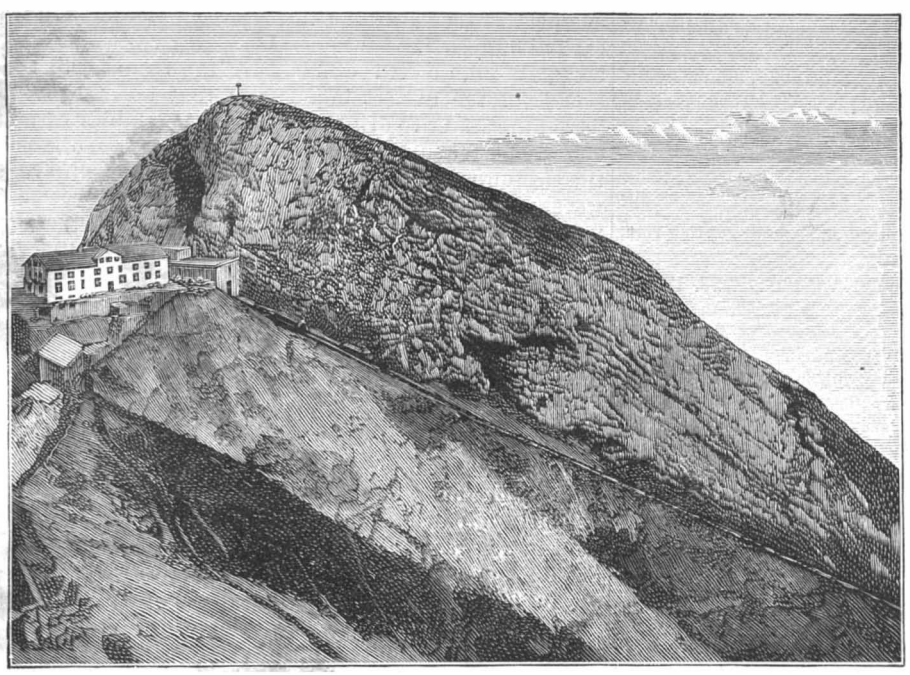
THE MOUNT PILATUS RAILWAY.

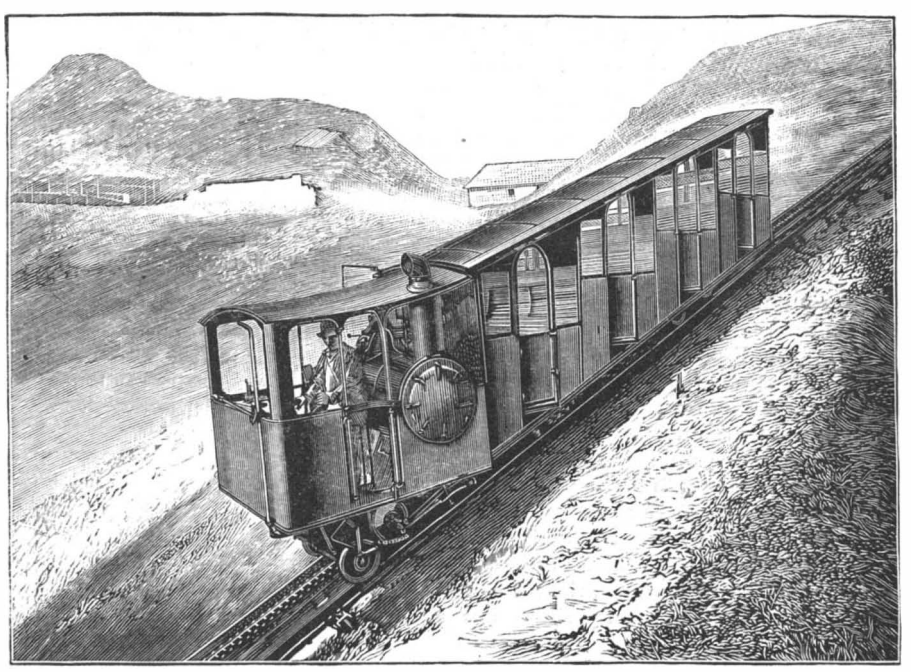
Thousands of tourists annually visit that favorite resort in Switzerland, the charming little city of Lucerne. One of the most impressive views there is the imposing form of Mount Pilatus, with its rugged and serrated peak towering behind the beautiful shores of the lake. Viewed from the shore, Pilatus—or, as the natives pronounce it, Pilat*is*—appears as a beautifully proportioned cone, terminating in a grayish-white apex called the Esel—which means the Ass; a vulgar corruption, by the way, of the ancient name "Etzel," a designation expressive of ruggedness and wild grandeur. But, while this appears the highest point, there is another peak, a little to the west, the Tomlishorn, which is really the summit, the heights being respectively 6,965 feet and 6,998 feet above sea level. But the Esel is the most conspicuous peak.

Two enterprising engineers of Zurich, Colonel Locher and M. E. Guyer-Freuler, conceived the startling idea of constructing a railway to that point, which has been constructed and has been worked, to the surprise and wonder of tourists, during the past summer.

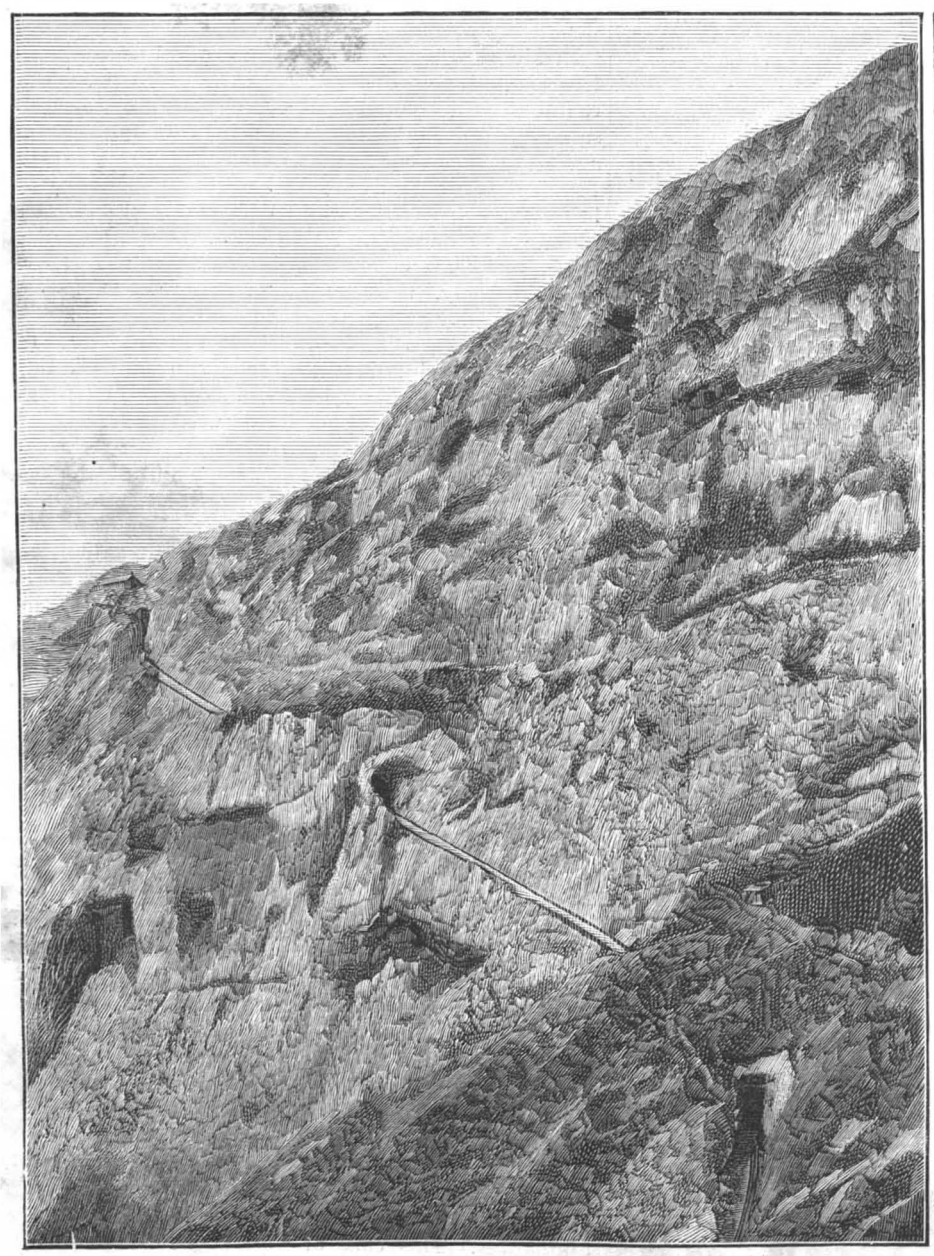
The starting point of the railway is at Alpnach-Staad. From the lake shore upward the foundation consists of a continuous wall of solid masonry, covered with immense slabs of granite. All the arches are of masonry, there being no dangerous iron bridges. The super-



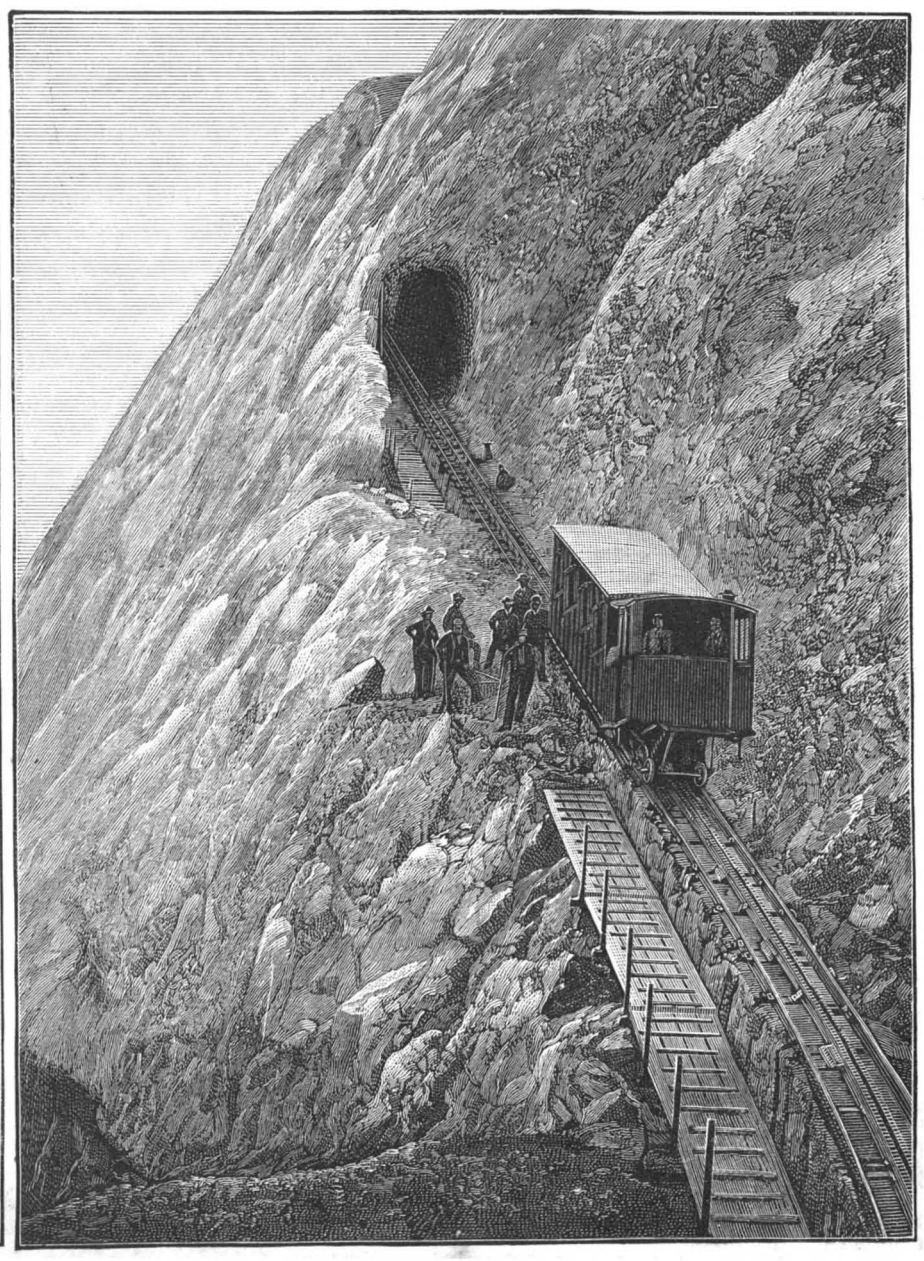
HOTEL BELLEVUE—HEIGHT, ONE MILE ABOVE LEVEL OF LAKE LUCERNE.



ENGINE AND CAR.



THE ESELWAND, SHOWING THREE TUNNELS.



THE SECOND TUNNEL.

MOUNT PILATUS RAILWAY, NEAR LAKE LUCERNE, SWITZERLAND.

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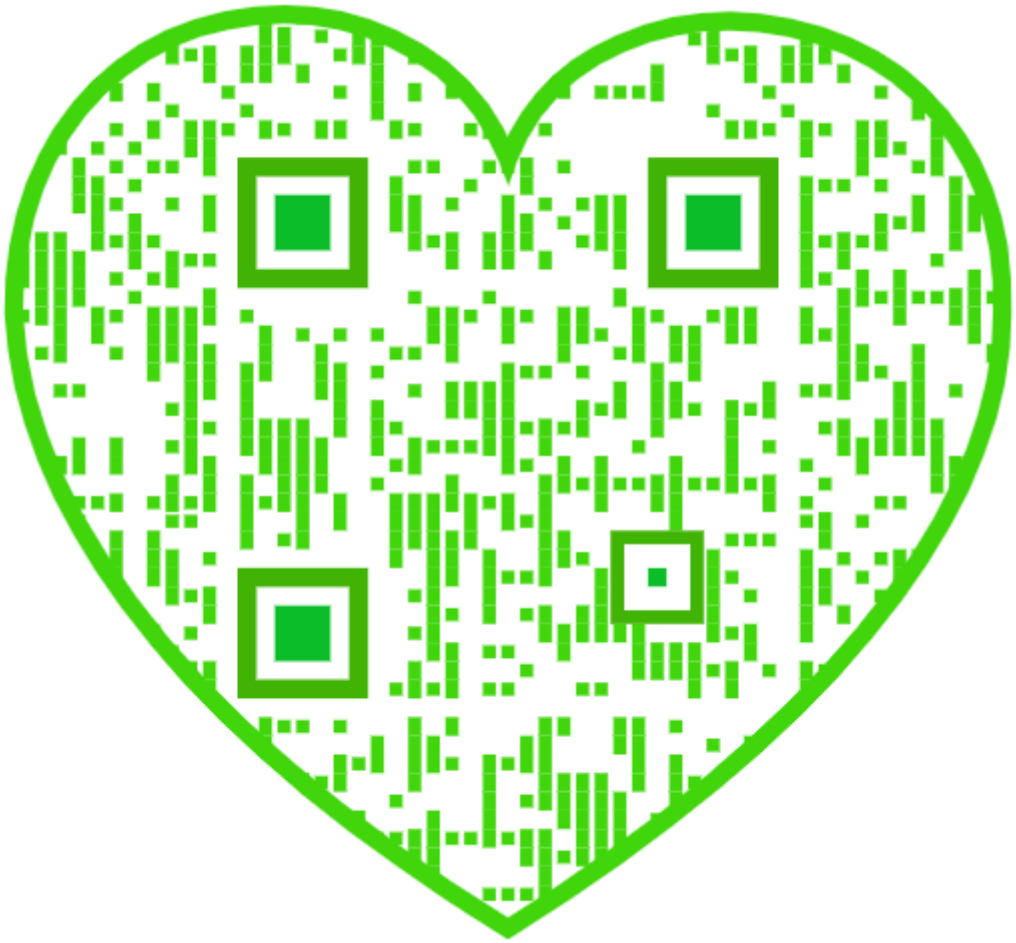

structure is of iron and steel, braced and bolted to the masonry yard by yard.

The rack rail runs midway between the two smooth rails, but at a somewhat higher level. It is wrought of steel, and has a double row of vertical cogs, milled of solid steel bars. Every engine and carriage has two horizontal cog wheels, which gripe the raised rail on either side. The brake can be applied in a moment, and there are, besides, vigorous automatic brakes. The locomotive and the carriage, with four compartments, each seating eight persons, is one piece of rolling stock. The boiler is placed crosswise. All the material is Swiss.

The speed, both in ascending and in descending, is 65 yards a minute, the mean gradient being 42 in 100, and the maximum 48 in 100. The actual length of railway is nearly three miles (5,049 yards), the work of construction having occupied two short summers only, as last winter tunneling work could only be carried on, and this at an altitude of 6,000 feet, where the cold was intense. The cost has been £76,000. It might be added that a glance at the train will satisfy the most timid as regards safety.

Leaving the terminus, the first point of special interest is the Wolfort Ravine, 865 yards distant, shown in our illustration, and where water is taken in. Here a grand view is afforded of the Alpnach Bay, right under our feet. Then follows the Wolfort Tunnel, and, climbing the slope, fine views are encountered till the Spycker Tunnel is passed and the Aemsigen Alp plateau is reached, where is the turntable for the crossing of up and down trains.

Now begins the ascent of the steep Eselwand, in fact, the mountain wall, where, at an altitude of 6,200 feet, no less than four consecutive tunnels pierce the huge body of the Esel, and between the second and third the grand Alpine panorama, with its glittering snowy peaks, extending from Appenzell to the Bernese Oberland, is suddenly unveiled to our astounded gaze. The line now rounds a rocky corner, and, as if making a final spurt, the engine emits a shrill whistle, that echoes and re-echoes from crag to crag, as it ascends the last and steepest incline, and enters, through a lofty archway, a building at the base of the topmost pinnacle. This is the Pilatus-Kulm station, the upper terminus.

We are 5,344 feet above the shores of the Lake of Lucerne, down yonder, and turning the corner of the old inn we gaze in astonishment and awe into the terrible abysses below. It is not in our province to describe in detail the view from the summit. Suffice it to say that it embraces the most beautiful uplands, the most rugged and awe-inspiring mountain scenery, blue lakes and rivers winding like silvery threads among forest-crowned ridges and fertile plains, while from east to west a frame is formed by the lofty glistening peaks of the snowy Alps—a view that is hardly surpassed in the world.—*Illustrated London News.*

A Railroad Dog.

Napoleon is a dog residing at Salida, Col., belonging to an engineer of the Denver and Rio Grande Railroad. He has been engaged with his master for the past two and a half years in running locomotive No. 86. His apprenticeship commenced at the early age of six months. His first trip was not a success on account of fright. This was speedily overcome. He can now go into the roundhouse, where twenty-eight engines are domiciled, single out and mount his own machine, and, in the absence of his master and the fireman, defend it against all intruders. He rides on the fireman's side of the cab, with both front paws and head hanging out of the window, intently watching the track.

He frequently scents cattle a mile or more distant. When they appear in sight he becomes greatly excited, looking first at the cattle and then at his master, as though trying to make him comprehend the gravity of the situation. On nearer approach he sets up a cry similar to that of a human being. If necessary to come to a full stop, he bounds out of the cab, runs ahead and loses no time in convincing the trespassers of the importance of finding some other stamping ground.

When necessary to communicate with help at the pumping stations, frequently at long distances from the track, a note is written and given to the dog, who delivers it and speedily returns with a reply.

Signals to start from his own engine are readily interpreted by him, but he pays no more attention to the whistles and bells of other engines than to cattle that may be safely grazing on the sides of the road. His olfactory powers are so keen that he has frequently given his master timely warning against stock, that, if struck, might have resulted disastrously. He is well known to all railroad employes between Ogden and Salida. If accidentally left at any of the stations, he returns to Salida on the first train.

IT has been freely asserted of late that the native oil supply of California had reached its maximum in that State as far back as 1883, and it does not admit of doubt that these assertions are true; for all the productive wells of the State are now at least six years old. The new drill holes are barren, and the flowing wells are gradually diminishing their output.

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THE FOOD AND CARE OF HORSES.

An interesting paper on the food and care of working horses was lately read before the American Street Railway Association, at Minneapolis, by Mr. Geo. G. Mulhern, of Cleveland, Ohio. In this paper and in the discussion which followed, considerable valuable information was elicited.

Mixed ground feed in small quantities and at short intervals is now universally conceded to be the best food. The feeder should always have the same horses under his care, so as to become acquainted with the habits and wants of each animal. When a team comes in from a trip, a handful of loose hay should be given. When feeding time comes, which should never be just before or just after a trip, the horse should have from six to eight quarts of ground oats and corn mixed with cut hay and dampened. Should be groomed twice a day. This makes the horse feel and do better. Mouth and nostrils should be sponged every trip. After the horses have stopped feeding, the feeder should see that each feed box is thoroughly cleaned. This is very important for the health of the horse. Iron and wood feed boxes should be avoided. The best feed box is the enamel-lined box, as the inside does not rust and is easily kept clean. If wooden boxes are used, the corners get foul, and it is difficult to clean them.

It is of the utmost importance that horses should have pure water to drink. Perhaps the stables of no city are better supplied with water than New York, as the Croton water is soft and good. But, like all river waters, it contains microscopic germs; and great advantage is found from its filtration and the addition of a little sulphur. An easily made filter is as follows: Over each trough a barrel is arranged to receive the Croton water, which is made to flow through the barrel to the watering trough. Fill the barrel one-third full of coarsely ground charcoal, over which sprinkle a little powdered sulphur. Upon the charcoal place some brush, and on this place clean gravel until the barrel is half full, or a little more, with the filtering material. This filter will last for six months or more without cleaning, and will supply clean water that the horses love to drink and by the use of which they are kept in first-rate health, without colics or other sicknesses. In the country, pure spring or well water, always filtered, should be provided.

The stables should be well lighted and ventilated. Disinfectants should be used.

Drivers should always have the same horses to drive, as they become thus more or less attached to these animals, take better care of them, are more careful to avoid strains in starting, etc.

In New York and Brooklyn, good car horses weigh 1,100 pounds, cost $150 to $160 each. Ten days' trial required. Flat-footed horses do not last well. Minnesota and Iowa horses prove good for New York. Average useful life of car horse in New York, three years; Brooklyn, four or five years. Chumpy, well built horses, free from tricks and defects, 15½ to 16 hands high, are in demand. As to color, the experience of Paris tramway companies is corroborated in New York, namely, that gray horses are the longest lived and give the greatest amount of service. The roan horse is equally good. Black and cream colored horses lack staying power, especially in summer. Bays show an average. Black-hoofed horses are the stronger and tougher. Select the hollow-footed horse.

We hope the suggestions given concerning the care of horses will be helpful to stablemen and all who have control of these useful animals. In cities like New York the grossest ignorance and carelessness prevails in the treatment of horses. Many of the animals are crowded into dark cellars and holes, which reek with filth, and the only wonder is they live as long as they do. In many of the best of the stables the atmosphere is bad enough to make a dog sick. A rigid system of inspection by qualified health officers is greatly needed here and elsewhere. No one should be allowed to keep a horse unless the animal is properly housed and cared for.

SAFEGUARDS AGAINST FIRES.

As the cold weather approaches, the more frequent conflagrations emphasize the necessity of looking after our fire-extinguishing apparatus. In city and country, in private house and factory, the water pipes and supply should be a special object of solicitude at this time. The causes of fires multiply with the cold, more open-fires are in use, furnaces are started, and defective flues and kerosene lamps begin to do their destructive work. The same cold weather that increases the sources of conflagration tends to impair the water supply of buildings and of street hydrants, so necessary for its extinction.

Before the winter has begun, the pipes and faucets should be inspected. Many factories and stores have automatic apparatus, including sprinklers and other appliances. This class of work may be permanently injured by freezing, so that it will be useless in summer or winter. But if not thus injured it may be rendered quite useless by the stoppages in the water flow caused by ice forming in the pipes, back of valves, or in exposed places. A small amount of ice may interfere

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with the turning of a stop cock. A minute spent in thawing it out when water is urgently needed may allow a fire to obtain considerable headway.

This is the season for carefully inspecting all such apparatus. Hydrants and valves should be examined, should be opened and shut, and oiled in order to insure easy working. The oil is not a matter of indifference, as some oil corrodes brass, and will do more harm than good. By one authority heavy mineral oil is recommended for the purpose. If this is properly made, it will never gum and will be non-corrosive. Sometimes the entire system of automatic sprinklers and connections are emptied of water and kept so, the main supply valve being permanently closed and pet and drain cocks being opened for a short time, to remove the contents. In such cases the pet cocks should be closed as soon as the water ceases running, and care should be taken to inform the proper people that the main valve for every alarm of fire is to be opened.

Although this course is spoken of as one often followed, it is not a good one. The essence of an automatic system is to be always ready. Where the turning of a single valve by hand is required, the system loses much of its value. It would be far better to run the pipes in such places that they would not freeze and to keep water permanently turned on.

To prevent pipes from freezing, wrapping in non-conducting material is often recommended. It does protect to a certain extent, but cold will in time penetrate the best packing. A very slow current of water through a protected pipe, however, will do more to prevent freezing than a more rapid flow through an exposed one.

Fire hose is in many buildings hung against the walls, and is coupled always to the water pipes. Such hose is often of no use, and is too weak to stand the strain of use. Purchasers of this class of hose are often asked if it is for actual use or merely to satisfy the fire inspectors. Of course a high quality is not needed, as it will never have over an hour's service to perform. But it should be able to resist the water pressure. When coiled, it should be properly done. If of rubber and coiled with "buckles," or sharp bends, these impair its efficiency greatly, and may lead to rupture.

Most of these remarks apply to factories, large stores and hotels. But the private house owner should watch his fixtures with equal care, and should be assured that at short notice water can be drawn on all the floors of his residence, and that buckets shall be at hand for instant use. Where a more complicated system cannot be obtained, the use of fire buckets placed in the hallways or convenient localities should not be omitted. Many a fire has been nipped in the bud, especially in localities where a flow of water cannot be reached, by means of this simple precaution. Perhaps in the distant future better building methods will be adopted by us, and our houses may eventually be less exposed to fire. Until that period we must not neglect appliances for extinguishing fires when they do occur.

James Prescott Joule.

Few greater or more successful workers in science have ever lived, says the London *Lancet*, than he who died at Sale on Friday, the 11th October, after many years of infirm health. It is too soon to appraise the full value of his discoveries, but this much is certain, that the name of Joule will take a place in the history of science parallel with, and in honor hardly inferior to, those of Dalton and Darwin. It may almost be said that Joule made physics an exact science. Such a statement would, of course, be paradoxical, for many good workers preceded, accompanied, and followed him. In his greatest work, the determination of the mechanical equivalent of heat, Joule was not wholly original, for that wonderful genius, Meyer of Heilbronn, a provincial physician, had very shortly before, and unknown to the English physicist, worked out the main conclusions on paper from theoretical considerations. But all this detracts nothing from the glory of Joule, who, by the most patient and intelligent labor, did the work and fixed the equivalent, which is now the starting point in so many studies in physics, chemistry, and biology. In the luster of Joule's greatest achievement his minor discoveries may possibly be overlooked. Fortunately the Physical Society of London have recently collected and printed his works, so that their full value may easily be esimated. In some of them he was associated with Sir Lyon Playfair, who has given to statecraft a mind which was meant for science.

THE remarkable growth and prosperity of the city of St. Paul, Minn., is well exemplified in the growth of its local newspapers. The *Pioneer Press* is an example. It has lately built and moved into its new building, which is a hundred feet square and thirteen stories high. Architecturally it is a magnificent structure, of the most solid and costly character. The printing department contains all the latest and most approved machinery and presses of the fastest kind, supplied without regard to expense.

The Seven Bibles.

The seven Bibles of the world are the Koran of the Mahometans, the Tri Pitikes of the Buddhists, the Five Kings of the Chinese, the Three Vedas of the Hindoos, the Zendavesta, and the Scriptures of the Christians.

The Koran is the most recent of the five, dating from about the seventh century after Christ. It is a compound of quotations from both the Old and New Testaments and from the Talmud. The Tri Pitikes contain sublime morals and pure aspirations. Their author lived and died in the sixth century before Christ.

The sacred writings of the Chinese are called the Five Kings, the word "kings" meaning web of cloth. From this it is presumed that they were originally written on five rolls of cloth. They contain wise sayings from the sages on the duties of life, but they cannot be traced further back than the eleventh century before our era.

The Vedas are the most ancient books in the language of the Hindoos, but they do not, according to late commentators, antedate the twelfth century before the Christian era.

The Zendavesta of the Persians, next to our Bible, is reckoned among scholars as being the greatest and most learned of the sacred writings. Zoroaster, whose sayings it contains, lived and worked in the twelfth century before Christ; Moses lived and wrote the Pentateuch 1,500 years before the birth of Christ; therefore, that portion of our Bible is at least 300 years older than the most ancient of other sacred writings.

The Eddas, a semi-sacred work of the Scandinavians, was first given to the world in the fourteenth century. —*Orange (N. J.) Journal.*

Capitalists and Inventors.

Inventors often complain of the difficulty experienced in inducing capitalists to join them in their enterprises. No doubt there is often good ground for such complaint. Not infrequently, however, we think the blame rests as much with the inventor as with the man of money. It must be remembered that usually the inventor studies the field more closely than the capitalist, because he has more time, and his attention is more closely directed to the investigation. It can hardly be expected that the man who devotes one hour to a superficial investigation of the subject can explore it so deeply and satisfactorily as the one who has given to it months and perhaps years. The capitalist is often blamed for not seeing into the advantages of an enterprise, when the fact is it has never been presented to him in the right light. Some one makes an important discovery, which, if utilized, will seemingly yield large results. Capital is invoked, but no systematic method is employed to demonstrate that the returns for an investment in working this new field of discovery will yield profitable results. Inventors too often think that capitalists should take their simple assertion that the invention will yield large returns. This would be very well if inventors as a class were not over-sanguine, and their predictions in a business way did not so frequently prove futile.

Every investor has a right to have some reasonable assurance that his money will be spent in a profitable direction. Money is the great lever that moves the world. If judiciously employed, it is a source of great gain; if wrongly employed, it too often becomes powerless for good. Every man, therefore, who would seek the aid of capital in furthering his plans for introducing an invention should first be prepared to show the whole state of the art covered by such invention, and wherein the improvement exists. Second, he should, if possible, show what particular market needs to be supplied with such improvement, and something approximating to the returns which reasonably may be expected. Third, he should have some well settled plan or introducing the new product or furthering the new scheme. Fourth, it should be supported by well considered arguments tending to the convincing of the men whose money will be embarked in the enterprise. Because, however sanguine the inventor may be, the man who is called upon to risk his money should be shown a reasonable hope for obtaining fair returns, and further, that investment is measurably safe.

The general denouncement of capitalists for their proverbial slowness in coming to the rescue of inventors is too often ill timed. There are millions of dollars to-day invested in experimental plants and in promoting new discoveries. We are glad to say that in the majority of cases these investments have proved very lucrative. Probably no field of enterprise offers more allurement than this, and if capital is not always secured, it does not follow that the man with the money is to blame. Inventors must employ business methods when approaching business men. If they are not capable of doing this, let them employ a third party, who, in many cases, furnishes the missing link between the patent and the bank account.

There are without doubt thousands of patents which have never been introduced to the public, which would yield very large fortunes to any one who would take them up and work them properly. Whose fault is it? Probably not the capitalists', for they are, generally speaking, only too glad to find a good way to invest their funds. The blame, if any, rests upon the inventor, who, in many instances, places so high a value on his invention that capitalists cannot afford to assume the risk of introducing the new thing, or because the inventor has not taken the right method or adopted the proper plan of bringing his matters to the attention of the men whose aid he invokes.

Inventors, often, get too easily discouraged. They bring their invention before three or four capitalists, none of whom feels disposed to introduce it, and they immediately give up, blaming the stupidity of capital, and bemoaning their own sad lack of funds. Now, the commercial traveler does not thus easily lie down under difficulties. He moves on from town to town. Each negative answer he gets only urges him forward to the man who he is sure sooner or later will be found to say yes. If the inventor had more of the commercial instinct, more of the commercial man's persistency and push, more of his indomitable will and pluck, he would succeed. There is far less trouble with capitalists than with inventors themselves. It really seems as though in most cases a "go-between" were absolutely necessary. When the inventor himself fails of eliciting help, the best thing he can do is to obtain the services of some keen, shrewd, far-seeing business man to help him out of his difficulty. If his invention is worth pushing, nine cases out of ten there will be little trouble in procuring financial help if the proper methods be employed.—*The Industrial World.*

Artificial Diamonds and Other Stones.

The display of artificial stones at the Paris exposition is said to have been most remarkable, and so perfect was their imitation of some genuine gems as to puzzle dealers and experts.

The firm of Regat & Sons, of Paris, produce such charming imitations of precious stones that they are almost justified in grouping them among the genuine jewels.

Another interesting exhibit of such artificial stones was shown by Charles Fell, of Paris, who is celebrated as a maker of optical glasses. Those of Fell were not so conspicuous perhaps as the stones of Regat & Sons. Still, they were remarkable, as by some chemical analysis—the same as is applied to precious stones—they were found to melt only at a very high degree of heat, and, of course, were exceedingly hard, in fact so hard that they would scratch and almost cut mirror glass. Not only in the scientific department, but in optical glass generally, France won distinction. Especially did her makers excel in glass articles for nautical purposes, as, for example, beacon light apparatus, and signal lamps for marine ships. Manufacturers exist there who devote themselves exclusively to the production and finishing of such articles.

Moreover, no country manufactures so many artificial pearls as France. For this purpose the glass used is the color of whey, and the glass pearl or bead is filled with a very costly solution prepared from the scales of fishes. A vessel holding a liter, about 1¾ pints English, is worth several thousand francs. They are of irregular sizes and forms, and are made to imitate pearls of black, gray, and other colors. When placed by the side of genuine pearls, even spread out and arranged in the same stringlike beads, it is not easy to discern between the genuine and spurious. The small imitations can, however, always be detected because of their perfect regularity and superior beauty. It is also asserted that they can be successfully made of the same specific gravity as the real article, so that no other proof of genuineness is reliable except the file. This is a means, since it would sometimes be applied to real articles, which requires the utmost care in the use. In a state whose industries have reached such a pitch of development, in which so much wealth and the love of luxury prevails, and to which the whole world looks by preference to supply the demands of luxury, many articles are brought to perfection and attain importance which would be profitless elsewhere.

Natural Gas in Utah.

At Ogden, Utah, natural gas was recently (October 1) discovered at a depth of sixty-three feet while boring for water.

When lighted for the first time, the flame shot up fifteen feet, impeded somewhat by an occasional discharge of mud and water. The pressure through an inch and a half pipe is about sixty pounds to the square inch, and has steadily increased, furnishing sufficient gas to light and heat fifty ordinary residences.

It is supposed to be a "marginal well," as gas in large volume is seldom reached at depths less than six hundred to one thousand feet.

If the active preparations now in progress to prospect the neighborhood for the "basin reservoir" are successful, it is expected, at greater depth, to obtain gas in sufficient quantities to furnish light, heat, and motive power for a large city.

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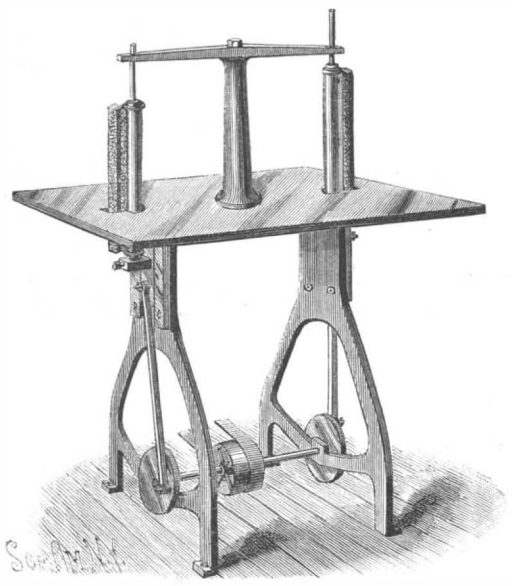
AN IMPROVED SANDPAPERING MACHINE.

A machine of simple construction, providing for the reciprocation of a sandpaper-carrying block, and for the ready renewal of the sandpaper upon the block, is shown herewith, and has been patented by Mr. Axel K. Hatteberg, of Marshfield, Wis. A driving shaft, with crank disks at each end, is supported between the standards of a suitable table, and near the ends of the table are mounted vertical slides, adapted to be

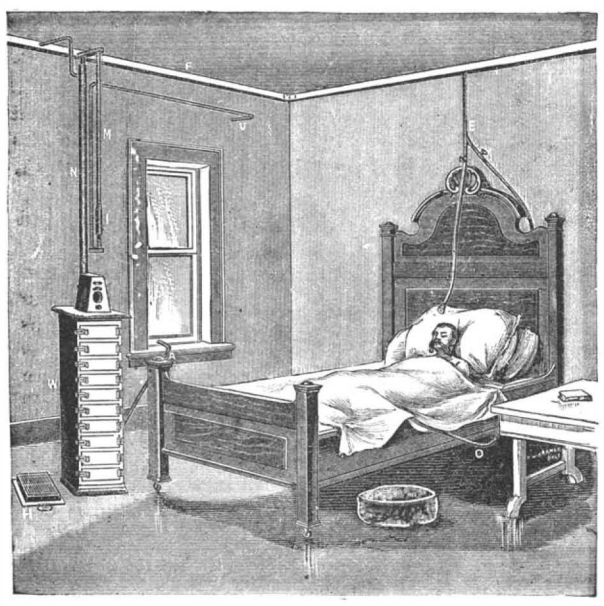


HATTEBERG'S SANDPAPERING MACHINE.

reciprocated by a connecting rod from the crank disks. Each slide has a projection to which is connected an upwardly extending stem, surrounded by a circular case with outwardly opening flanges. To these flanges, by means of thumb-nuts and bolts, are clamped blocks, which may be of any desired form in cross section, and covered by a strip of sandpaper, the inner end of which is coiled about the vertical stem within the case. The upper ends of the stems pass through apertures in the outer ends of a double-armed standard fixed to the center of the table, the machine shown being a double one, at which two operators may work simultaneously. The material to be operated upon is placed upon the table and pressed against the sandpaper carried by the blocks.

AN AIR PURIFIER FOR SLEEPING APARTMENTS, SICK ROOMS, ETC.

An apparatus for supplying purified air to a room, by bringing an incoming current into contact with



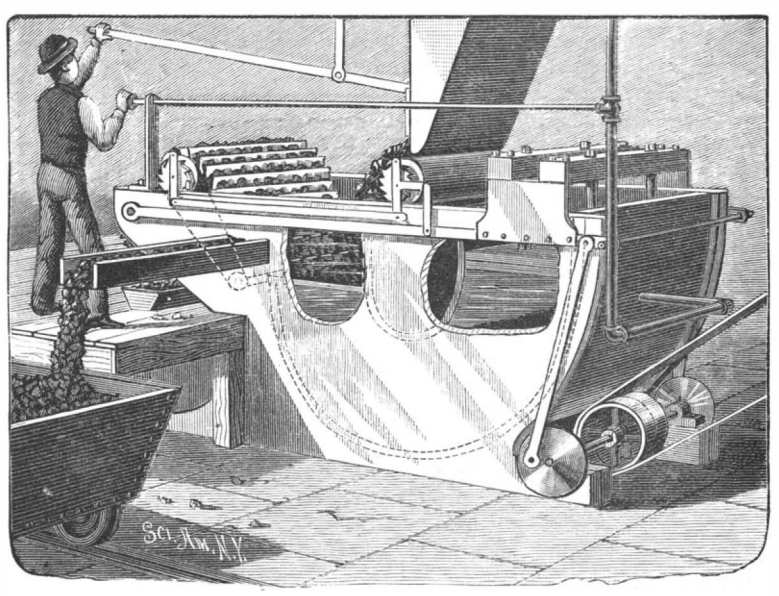
BENSON'S AIR PURIFIER.

antiseptics, the air then passing through a heating chamber, is illustrated herewith, and has been patented by Mr. Benjamin S. Benson, of No. 512 East Monument Street, Baltimore, Md. The air is taken in by a pipe through a hole in the lower window strip, to the lower compartment of an adjacent bureau-like filtering case, there being in the case a number of compartments in which are filtering webs coated with a suitable absorbent, usually gypsum, to extract the water and fix the ammonia of the atmosphere. At the top of the case, and connecting therewith by a series of apertures, is a chamber in which is a lamp, this heating chamber causing an in-draught of air which must pass through the several filtering webs. In this chamber the air may be heated as high as 250°, to destroy any living germs, and above the chamber is an extension or drum, centrally within which is a combustion pipe connected to discharge outside the building. To the upper end of the drum is connected the pure air pipe, concealed under the cornice, a branch from this pipe leading to the head board of the bed.

Ordinarily the air will be sufficiently cooled by its passage through the pipes, after leaving the heating chamber, but a cooling box may be interposed at any convenient point, if the further cooling of the air be deemed advisable. Stop-cocks are provided whereby the flow of the air may be regulated, and, with flexible pipes, it will be readily seen that the inflowing current of pure air may be conveniently directed at will to any desired point.

IMPROVED COAL WASHER AND SEPARATOR.

A machine for coal and ore washing and separating, in which water is forced through the coal or ore, and the grading or separating is effected by the gravity of the material operated upon, is shown in the accompanying illustration, and has been patented by Mr. Peter C. Forrester, of Wilkeson, Washington Territory. The main chamber of the machine is preferably made of wood, in U-shape, concentrically curved outer and inner walls forming a water chamber with two short legs, in one of which is fitted to reciprocate a plunger, its bearing edges having watertight contact with the side walls of the water leg. Our view is in perspective, with parts broken away to show the interior. On the ends of the timbers to which the plunger is secured are bolted depending bracket plates, the lower portions of which are secured to the side faces of guide bars pivoted one on each side of the main frame at the opposite end of the machine. The plunger is reciprocated by pitmen, adapted to be pivoted in different positions near the ends of the guide bars, whereby the stroke of the plunger is regulated, the lower ends of the pitmen being pivoted on crank disks on a shaft receiving motion from any suitable prime mover. In the water leg on the side opposite the plunger is fixed a horizontal screen plate or diaphragm, at the outer side of which is a transverse trough, open on its upper side, and on its under side forming, with the walls of the chamber, a throat-like passage to the bottom of an upwardly widening chute-shaped extension. In this chute, supported by top and bottom revoluble drums, is an elevator belt with spaced buckets, for discharging the waste material passed through the throat-like passage to a receiving trough at the end of the machine, the transverse trough discharging the coal, when the machine is used for washing and separating coal. The hopper furnishing the material to be worked is supported above a feed roll which discharges upon the screen plate or diaphragm, there being at the lower end of the hopper a gate controlled by a pivoted lever, extending to within easy reach of the operator, whereby the quantity of coal or ore fed to the machine may be regulated. Motion is given to the feed roll, as the plunger is reciprocated by the pitmen, by bell crank lever arms, on each side, through a short link, which is also pivoted to each side guide bar. To a depending limb of the bell crank lever is also pivoted one end of a connecting rod whose other end is jointed to a ratchet bar by means of which, through a ratchet wheel, the upper one of the drum shafts carrying the elevator belt is operated. The valve rod of the inlet opening through which the machine is supplied with water extends to within convenient reach of the operator, and also a lever controlling a water discharge valve, so that the quantity of water needed for the work may be readily regulated. In operation, the reciprocation of the plunger causes a pulsating action of the water up through the material fed upon the perforated screen plate or diaphragm, partially floating the coal, while the heavier portions find a lower level, and are crowded out through the throat entering the lower end of the chute, the coal being passed into the transverse trough to be discharged at the side of the machine. If it is found that there is too free a removal of waste, so that the coal is also taken out with it, the operator can readily throw the pawl of the ratchet gear out of mesh, and thus stop the working of the elevator. In using the machine to wash and separate mineral ores, the waste being lighter is passed into the transverse trough, while the concentrates of mineral are taken up by the elevator. Several of these machines are now in use by the Wilkeson Coal and Coke Company, and they are said to be capable of cleaning 125 tons of coal per day over a screen surface of 2½ by 2½ feet, the coal being used for making coke.



FORRESTER'S MACHINE FOR WASHING AND SEPARATING COAL.

Large Rolls.

The Pittsburg *Dispatch* says: The Phœnix Roll Works, at Forty-first Street and the Allegheny Valley Railroad, have just turned out a pair of the largest rolls ever manufactured. They weigh 92,000 pounds, are 142 inches in length, and measure 48 inches in diameter. The moulds in which the rolls were cast had to be specially made, and were 160 inches in length and 60 inches in width.

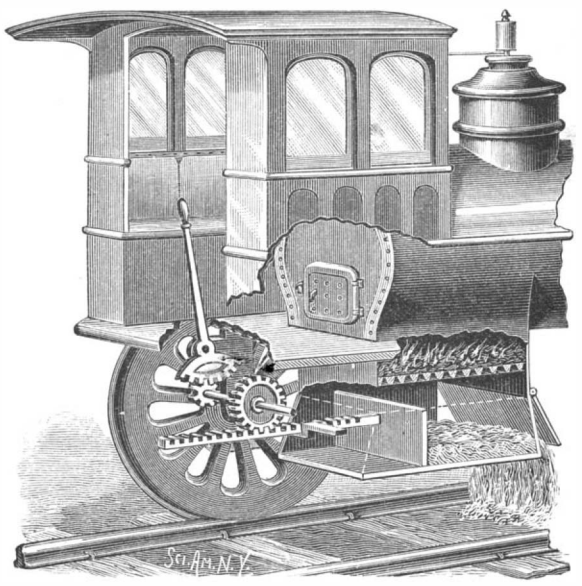
The firm possesses facilities for such heavy work, and by means of the powerful 80 ton cranes were enabled to handle the huge mass at will. The rolls were made to the order of the Cambria Iron Works, and were shipped to Johnstown recently.

They will form part of the new steel rail plant now in course of erection, and which will be one-third larger than that destroyed in May.

The Phœnix Roll Works have also lately completed two pairs of armor plate rolls for Carnegie & Co.'s Homestead Works, which have a rolling space of 120 inches, being 132 inches wide. Each pair weighs 17½ tons. These are the largest armor plate rolls yet made.

AN IMPROVED LOCOMOTIVE ASH PAN CLEANER.

A device by means of which a locomotive ash pan may be conveniently cleaned when the engine is in motion is illustrated herewith, and has been patented by Mr. Alton H. Smithson, of the East Tennessee, Virginia, and Georgia Railroad shops, Atlanta, Ga. In the ash pan is arranged a pusher, consisting of a plate extending from side to side of the pan, the plate being rigidly connected to a rearwardly extending rack, above which is mounted a shaft carrying a gear and pinion, the gear engaging the rack while the pinion is engaged by a segmental rack rigidly connected to an upwardly extending lever fulcrumed to any convenient support, the handle of the lever being within easy reach of the fireman. The rear end of the ash pan is open, but may be closed by moving the pusher fully back in the pan, the forward end of which is normally closed by a hinged door, which is arranged to open by the pushing of the ashes against it, as the fireman, by means of the lever, moves the plate pusher forward in the ash pan. This pusher may also be made to serve as a damper when so desired, permitting the entrance of air when slightly advanced.



SMITHSON'S LOCOMOTIVE ASH PAN CLEANER.

A French Subterranean River.

A subterranean river has just been discovered in the district of Miers, in the Department of Lot. Miers is in the heart of a wild, mountainous country, in the deepest recesses of which caves and grottoes are found. The other day two explorers—M. Martel and M. Gaupillat—discovered the river at the bottom of an abyss known as the Pit of Paderac. With a folding boat, made of sail cloth, they worked their way down stream for a couple of miles through a succession of wonderful grottoes sparkling with stalactites. They found seven lakes on their way, and had to shoot thirty-seven cascades or rapids. The two explorers intend to start on a fresh expedition to ascertain, if possible, the outlet of this unknown river. They conjecture that it joins one of the heads of the Dordogne, six miles from the abyss.

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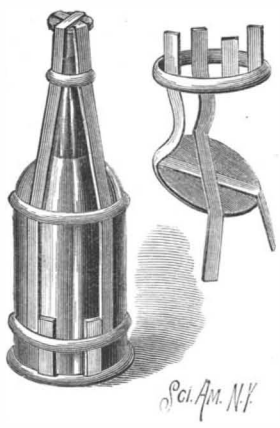
AN IMPROVED BOTTLE PROTECTOR.

A protector with which bottles may be conveniently packed without the use of straw or similar material is shown herewith, and has been patented by Mr. August H. Keltow, of Telluride, Col. It is preferably made of rubber, with an upper and lower disk adapted to cover the head and body of the bottle, and to these disks are connected strips which pass over the top disk and are secured to the upper face of the bottom disk. The strips carry two or more body rings, and a small ring for the neck, and the outer faces of the rings are preferably made convex in form. One end of each of the strips is connected to the lower ring, the other ends being arranged so that when the bottle is in place within the protector, they may be tucked under the ring.



KELTOW'S BOTTLE PROTECTOR.

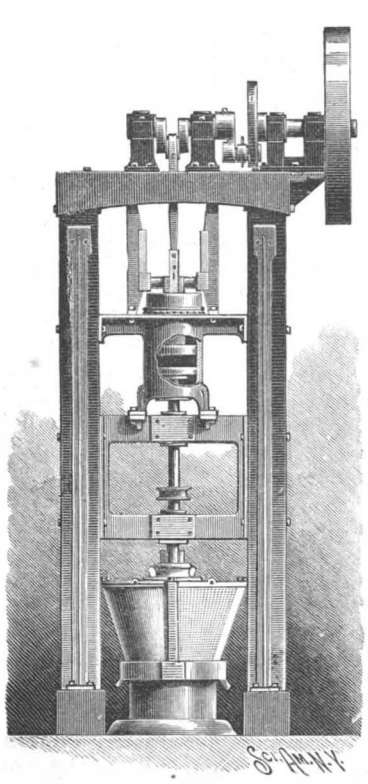
AN IMPROVED BISCUIT CUTTER.

The biscuit cutter shown herewith has been patented by Mr. Henry T. Sidway, of No. 59 Dearborn Street, Chicago, Ill. The cutters have the usual beveled cutting edges, and are attached to a curved bar, the angular spaces between the cutters having a filling of solder. The curved bar has upward extensions at its ends, to which the handle is secured, and the cutter is used by pressing it upon the dough with a rocking motion, to cause its entire under surface to come in contact with the board.

SIDWAY'S BISCUIT CUTTER.

AN IMPROVED STAMP MILL.

A stamp mill in which a cushion of air is interposed between the driving mechanism and the stamp, making an elastic connection, whereby the blows of the stamp are accommodated to the thickness of ore in the mortar, is illustrated herewith, and has been patented by Mr. Charles H. Krause, of Lake Linden, Mich. Between the uprights of the main frame, and below the crank shaft, a cylinder is rigidly secured. The crank is connected to the crosshead by a connecting rod of the usual form, and to the under side of the crosshead is attached a short hollow piston rod, divided into upper and lower compartments, the piston being adapted to be fitted with an airtight packing. In the central part of the piston are exhaust valve openings, covered by a valve in the lower compartment of the hollow piston, the valve rod passing through an aperture to the upper compartment. This valve rod passes through a screw-threaded sleeve, which also forms an abutment for a spring placed on the valve rod, giving more or less compression to the spring. In the side of the hollow piston is a pipe communicating with an exhaust pipe extending out of the building, and in the sides of the cylinder, near its upper end, is a series of holes. In the lower part of the cylinder is a separate piston, also adapted to be fitted with an airtight packing, and this piston is secured to a flange on the upper end of the stamp rod, a grooved pulley on this rod receiving a round belt to impart a slow rotary motion to the stamp. The crankshaft is operated by means of gears to give a quick downward and slow upward movement of the crank, and when the top piston is raised, a partial vacuum is formed between the two pistons, whereby the lower piston is raised, bringing with it the stamp rod. As the upper piston passes above the holes in the sides of the cylinder, air is admitted between the two pistons, and when the upper piston is again quickly forced downward, it also forces the lower piston down through the medium of the interposed air cushion, preventing the breakage of the driving machinery in case there be an undue quantity of ore in the mortar. The exhaust valve in the upper piston is lifted by the spring on the valve rod, to permit of the escape of the air as the piston completes its downward stroke, the pressure at which the exhaust valve is allowed to rise being regulated by raising or lowering the sleeve on the valve rod.



KRAUSE'S ATMOSPHERIC STAMP.

Sewage Schemes.

Plans for the purification of sewage, says the *Chemical Trade Journal*, still fill the air; what with herring brine, "ferozone," electricity, and other agents and chemicals to boot, the ordinary health committeeman has a lively time of it. The question may be asked, Are we any nearer the true solution of the problem than we were twenty years ago? to which we feel constrained to reply, No.

Why is it, then, that we are no nearer the acme of perfection in this matter than we were two decades since?

The reply is a simple one. It is because engineers have vainly considered this subject to be one with which they could deal successfully without any help from the outside.

The fact is, however, that the sewage purification problem lies midway between engineering and chemistry, and we do not believe that either a chemist, pure and simple, or an engineer has all the knowledge necessary to enable the treatment of sewage to be brought to a successful issue. And further, we are of opinion, adds the *Journal*, that a merely scientific chemist will attack the problem in vain; the man who solves the sewage question must be a technologist of no small reputation; a man who has seen a deal and thought a lot.

If this point be conceded, we would like to know why it has never been acted upon, and if it be not conceded, we will willingly open our columns to a discussion of the subject.

Tensile Tests at Varying Temperatures.

M. Andre le Chatelier has recently made a number of experiments on the tensile strengths of metals at varying temperatures. The specimens tested were annealed wires ¼ inch thick, which were heated in an air bath. The results obtained are given in the following table, the figures being the breaking strengths in tons per square inch:

	Temperatures. Centigrade.								
	15 deg.	100 deg.	150 deg.	200 deg.	250 deg.	300 deg.	350 deg.	400 deg.	460 deg.
Copper	16·0	14·5	12·0	10·7	8·8	8·1	6·0	4·4	2·3
Aluminum	11·7	9·5	8·1	6·3	4·8	3·6	2·4	1·5	1·0
Nickel	35·0	35·0	35 0	34·9	34·2	32·3	27·9	23·4	19·3
Silver	10·9	10·1	8·6	7·2	5·6	4·5	3·8	3·3	3·0
Aluminum bronze	33·8	33·3	32·3	31·2	29·8	28·1	23·4	14·7	6·3
Copper, iron, nickel	26·9	26·8	26·3	25·8	24·9	23·4	17·7	11·6	5·0
Zinc	7·9	1·5	0·6	0·4	..	0·4	..	..	.

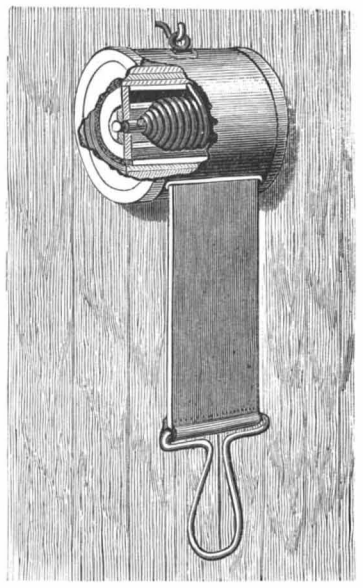
AN IMPROVED DRIVE CHAIN.

A drive chain so made that the links are held from accidental displacement, and can be separated only by purposely moving the parts to an abnormal position, is shown herewith, and has been patented by Mr. Ebenezer S. Jennings. Fig. 1 represents such a chain in use, Fig. 2 showing a longitudinal section of a coupler uniting two links, Fig. 3 showing the parts as they appear when the links are to be coupled, and Fig. 4 a plan view of the links and coupler. The side lengths of the links have inwardly extending projections, and the end bars are centrally flattened to form recesses. The coupling block has two circular recesses, overhung by jaws having projections, the central rib by which the recesses are divided being formed with shoulders between which there is an upwardly extending projection. The links having been connected, they can only be separated by turning one of the links up over the coupler until its recesses register with the coupler projections, or the coupler may be turned down to bring about the desired register. A chain thus made may be used as a driving chain, a conveyer chain, an elevator chain, etc., and is exceedingly flexible. For further information relative to this invention, address the Nelsonville Foundry and Machine Company, Nelsonville, Ohio.

AN IMPROVED RAZOR STROP.

A novel device to facilitate the stropping or sharpening of razors, and designed to be hung upon a wall, window casing, dresser, or other convenient place, is illustrated herewith, and has been patented by Mr. A. D. Ray, of Elgin, Ill.

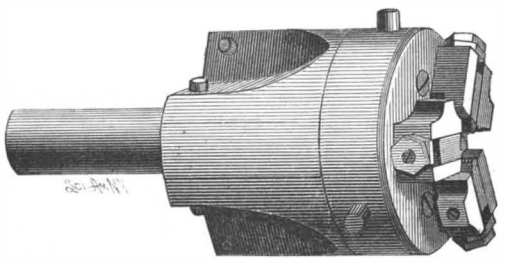
It is a dust proof, flexible razor strop, consisting of a cylindrical metallic box, having a slot on one side through which the strop passes, and a swiveled eye and hook on the other side, by which the sides of the strop may be reversed, presenting either side for use. Through the center of the box extends a wire shaft, to which is attached a longitudinal coiled spring, the spring at its other end being attached to a roll which revolves freely on shaft, and one end of the flexible strop is fastened to the roll. The strop is readily withdrawn or reeled off for use, and when released will immediately reel itself on the roll within the box, by the tension of the spring. The flexible strop may have both sides of leather, or one side leather and the other of canvas.



RAY'S DEVICE FOR STROPPING RAZORS.

AN IMPROVED SCREW-THREADING DIE.

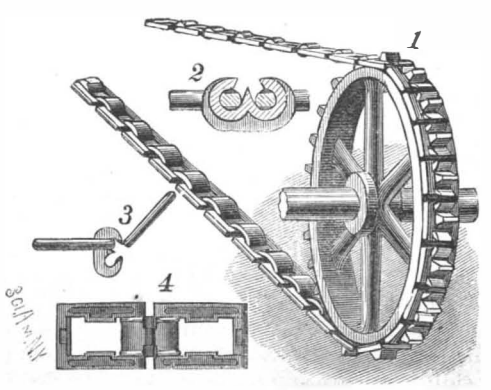
An improvement in die heads adapted for use in connection with lathes, screw machines, bolt cutters, and similar machinery, has been patented by Mr. John N. Severance, and is shown in the accompanying illustration. The die head has a reduced forward end and a series of longitudinal recesses in the outer face having an inclined base wall, a spring-actuated die-carrying jaw being hinged in each recess, while a cam ring is held to revolve upon the head in contact with the free end of the jaws, the ring having internal recesses corresponding to the number of the jaws. This ring is held in position by a cap plate screwed upon the front face of the body, and slotted to admit the passage of the jaws, and also centrally apertured to expose the counterbore. By turning the cam ring in one direction, the recesses are brought into registry with the jaws, when the springs force the jaws into the recesses, and the dies are withdrawn from contact with the work, and may be removed or shifted, while a further revolution of the ring forces the jaws inward until the dies are firmly held in a cutting position. This die head is simple and compact, and is made to hold the work with extreme rigidity, while it obviates the necessity of reversing the motion of the spindle of the machine while cutting threads upon screws or bolts.



SEVERANCE'S SCREW-THREADING DIE.

For further information relative to this invention address the Leckie Button and Manufacturing Co., Green Street, Jamaica Plain, Boston, Mass

THE Bank of California has a large force of men at work constructing an irrigation canal fourteen miles long, to irrigate a tract of 50,000 acres that the bank owns in Fresno County. The canal will be 60 feet wide and 6 feet deep. This tract of land will be cut up into 20 acre farms and placed on the market.



JENNINGS' DRIVE CHAIN.

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THE CONGRESS OF THE THREE AMERICAS.

In response to an invitation extended by the President of the United States on the special authorization of Congress, delegates appointed by all the states of Spanish America, that is to say, Mexico, Central and South America, arrived in Washington last September to take their places in an International Congress, called with a view to foster amicable relations and encourage trade between peoples whose destiny and interests would appear to be identical. The seventeen countries represented have a total population roughly estimated at 50,000,000, and a trade which is shown by reliable statistics to have an aggregate value considerably above $1,000,000,000; the share of the United States in the same having been in the year 1888 only $244,219,000; buying from them $175,229,000, or about 35 per cent of what they had to sell, and selling them $68,990,000, or about 15 per cent of what they required.

A glance at these figures shows that trade between our neighbors and ourselves is not reciprocal, and from a study of their necessities and our own resources it will clearly appear that if proper transportation facilities existed, we could supply a much larger share of their wants.

The International Congress met and organized on October 2, but before it began its deliberations it was thought advisable to give the delegates a practical demonstration of the extent and nature of the resources and manufactures of this country; and hence, as guests of the nation, a special train was made ready for them, and on October 3 they set out for a view, though necessarily a hasty one, of the great republic.

The special train was made up of six Pullman coaches of the latest pattern, fitted with kitchen, dining room, and living apartments of the most elaborate kind; a powerful engine, No. 1,053 of the Pennsylvania Railroad Company, drawing the train, and having special arrangements for supplying steam, heat, and an electrical current for lighting the cars.

The trip included fourteen States, the details of which will be given further along.

On November 13 the train rolled into the Baltimore and Potomac station in Washington, and the sight-seeing excursion of the delegates of the All-Americas was at an end for the present. Forty-one days before, the same train, the same engine, had left Washington on a schedule made out by the Pennsylvania Company, and after a run of 5,825 miles was returned exactly on the minute, as set down on the printed card furnished the delegates on setting out. The enormous expanse of territory covered, the number of roads traversed without stoppage or delay, but, above all, the power exhibited by this American locomotive, which never failed from start to finish, makes this trip, so say the best authorities, unequaled in the annals of railroading, and illustrates the splendid conditions attained by the principal railways of this country.

Here is the record of the trip:

A visit to the principal works and points of interest in New York City, a visit to the West Point Military Academy, thence to Boston, to Lawrence, and the great cotton mills on the Merrimac River, from which 4,500 of the 9,000 horse power used in the mills is derived, the mills turning out 100,000,000 yards of prints yearly, employing 6,000 hands and using 50,000 spindles and printing machines. At Lowell, the next stop, they visited the great shoe manufactories, then to the great machine shops at Worcester, Mass., next to Willimantic, Conn., where they were shown through the great spool cotton mills; at South Manchester they visited the Cheney silk mills, the largest in the country, where 2,000 hands are employed and 2,500 looms are kept running with a daily consumption of 500 pounds of raw silk and 2,500 pounds of cocoons. At Hartford they visited the Colt armory works, which cover 300 acres. Here they saw the steel worked into revolvers and rifles and witnessed the working of some of the 35,000 machines employed in making arms, graphophones, printing presses, type setters, and engines; the same requiring the services of 12,000 men. They tried the new Colt rifles that fire 15 shots in 7 seconds and the Gatling guns. Then came a visit to the Pratt & Whitney gun shops, the multicharge gun shops, the bicycle works, the Hartford screw works, where the delegates saw rods of metal turned by automatic machinery into screws ranging in size from ponderous bridge bolts to the most minute watch screws; thence they went to the Caligraph works.

At Collinsville, Conn., they saw machets being made to fill South American orders, and were presented with bowie knives made on the spot as souvenirs.

At Meriden they visited the silver plating works. At New Haven they visited Yale College, being received by President Dwight. At Springfield, Mass., the National Armory was visited, where they saw the famous rifles turned out at the rate of 140 per working day, also the new type bayonet, which looks like a sharpened ramrod. As they went by Brightwood in their special train, a rhythmic salute of powerful whistles drew their attention to a car factory on a near by siding, discovering a line of cars intended for Chili, as could be seen by the letters upon their sides. At Holyoke, Mass., the delegates saw the magnificent dam across the Connecticut River and were shown through some of the famous paper works. At Albany, the capital of New York, the route to the new capitol building was illuminated with lamps and Chinese lanterns, the Tenth Battalion of Infantry and a band leading the way. Niagara Falls was next visited, and the delegates, embarking on the little steamer Maid of the Mist, were taken up near to the foot of the Falls. Cleveland, O., Detroit, Mich., and Ann Arbor were next visited, then Grand Rapids, Mich., and South Bend, Ind. At the exposition which was being held in the latter city, an incident occurred which strikingly illustrates the pressing need for more direct intercourse with the republics to the south of us.

Senor Guzman, of Nicaragua, coming upon an all-wool fancy cassimere, exclaimed with astonishment at its low price. "Why," said he, "in my country, I have to pay from $5 to $6 a yard for it, and here I find the price is only $1.15 a yard." Mr. C. B. Van Pelt, secretary of the company which manufactures the goods, overheard the remark and explained to Senor Guzman that the reason for the exorbitant price in Nicaragua was that the goods, in order to reach his country, had to go from South Bend to Liverpool, and thence through France to reach Central America. "If we had an American line of steamers," said he, "the South and Central Americans would save money, and we would make a better profit."

At South Bend the delegates were shown through the Studebaker wagon factory, the largest in the world, there being more than a mile of shops, where every kind of road vehicle is made, and where quite 40,000 vehicles are yearly turned out, an automatic machine for setting spokes in a hub attracting marked attention.

A great shirt factory was next visited, where one hundred dozens are turned out in a day. Then the largest plow factory in the world, where the Oliver chilled plow is made. They saw a steel beam for a plow taken red hot from the furnace, in a straight piece, put in a machine to which one twist was given by a lever and the beam was bent in shape as easily as a piece of paper. One of the workmen can put together in one day nearly 500 of the handles.

At the case factory of the Singer Sewing Machine Company there was much of interest to be seen, the company, so it is said, having 40,000 employes scattered over the world and an invested capital of $40,000,000. Twelve million feet of lumber and 500,000 pounds of glue are used every year in the South Bend factory.

In the room in Mr. Studebaker's house where the delegates dined hung a picture of a humble village blacksmith's shop, where the present millionaire carriage builder, with now the largest carriage shops in the world, began his career. It may be remarked in passing that one of the storage rooms of the Studebaker works is 1,000 feet long, and that still larger shops are about to be added.

At Chicago a regiment was drawn up to escort the delegates to their hotel, and the streets were almost impassable with the crowds gathered to see them.

At the Armour Mission they were shown 1,500 of the city's poor children. They visited the public works, were taken out upon Lake Michigan and shown the mammoth pipe for conducting pure water to the city, and visited the great slaughter houses. At Milwaukee a tour of the breweries was made, and thence they went to the National Soldiers' Home on the outskirts. The next stop was at St. Paul, Minn., where the flouring mills and granaries were inspected. At St. Louis the great manufactories were visited. At Kansas City, Mo., the delegates were driven out to the smelting works in the suburbs, where large amounts of Mexican ore is handled. Each delegate was presented with a silver medal the size of a dollar, bearing on one side emblems of commercial unity and the legend, "The United Americas—Commerce, Reciprocity," and on the reverse side, "The Consolidated Kansas City Smelting and Refining Company to the All-Americas Congress, Greeting."

At Cincinnati the delegates were driven to the polls, it being election day, and shown the methods employed in receiving and counting votes, looked at the famous inclined planes, and in the evening were taken to the office of the Board of Elections, where they witnessed the reception of the election returns. Pittsburg, Pa., and McKeesport were next visited. They saw a 20 ton steel ingot emerge from the mould to be squeezed by automatic machinery, rolled, clipped, and sheared till transformed into sheathing for the steel cruiser now under construction at San Francisco. They were shown the largest hydraulic shears in the world, cutting boiler plate as a seamstress would cut a piece of cambric. Then there was the rolling of railroad rails, tube making, and the like. At the Exposition building, whither the party went in the evening, there was an unsurpassed showing of electric lights, arc and incandescence, by rival companies; one of the companies, so it was said, having expended $10,000 for the especial purpose.

"The spectacle of the evening was viewed from a balcony on the river side of the building. At a signal the natural gas flowing from four stand-pipes, each four inches in diameter, was ignited, and four flames shot fifty feet in the air. The heat from them was so intense that, though they were 200 feet away, the spectators had to shield their faces.

"Suddenly a column of water shot up from the river surface, a rocket was forced into the turmoil of water, and instantly a tower of flame 100 feet high shot into the air. A gas main which had been run out on the river bed provided this wonderful exhibition. From another pipe leveled over the water shot another flame, and its color, by the injection of different chemicals, was changed to blue, yellow, and green.

"At the close of the display the five enormous volumes of flame and the huge tower which shot from the river were going together; then came the boom of a cannon, and the gas was turned off, ending a display which astounded the visitors and thousands of spectators who thronged the Exposition premises."

Leaving Pittsburg, the special train, the engine draped with the national colors, climbed the western slope of the Alleghany Mountains, opening to the eyes of the delegates that picturesque region of wooded steeps, mighty precipices, and verdant valleys so potent to charm the stranger. At Jeannette a stop was made to witness the process of window glass making on a grand scale by the continuous Belgian process; the glass being blown into long cylinders and cut up into panes of various shapes and sizes.

Then came a stretch of road along Conemaugh's fatal banks and a wind through ill-fated Johnstown, thence through mountain passes to Altoona. Here the great shops of the Pennsylvania Railroad Company were inspected, shops, be it said, which employ nearly 3,000 hands and turn out 25 engines, 500 freight and 20 passenger cars every month, besides attending to the demands and repair of a great railroad system. Philadelphia came next on the route. Here the University of Pennsylvania was visited. At Tacony, a short run out from the Quaker City, the delegates were shown about the Disston Saw Works, where they saw scraps of steel turned into ingots, then into sheets, and thence into all kinds of saws, from the miniature fret saw blade up to circular saws of 84 inches diameter. The tooth cutting and grinding was also exhibited.

By steam from Tacony, Cramp's ship yard was visited, the delegates boarding the new steel cruiser Baltimore, thence going to the dynamite cruiser Vesuvius; the work on the cruisers Philadelphia and Newark was also studied, as well as that on a big mercantile steamer called the Venezuela, intended to ply between New York and Philadelphia. At the invitation of Mr. G. W. Childs, the press rooms of the *Public Ledger* were visited.

On the 9th of November the delegates were taken to Annapolis on a visit to the United States Naval Academy, where they saw a naval parade, a big gun drill, and a march-by of blue jackets.

On their return to Washington, the delegates expressed surprise at what they had seen. The quality of the manufactured goods, as well as the quantity, had struck them forcibly, but above all else the application of machinery on so grand a scale, the ingenuity of its construction, and the military-like order and precision of the armies of workmen and artisans in the great mills and shops, won their admiration.

Transportation facilities, and a study of the credit system in vogue along the Spanish Main, is all that is needed, so the delegates declared, to make us a power in the vast market stretching south from the Mexican border to the great Argentine city of Buenos Ayres.

Judge Jose Alfonso, delegate from Chili, said: "Chili needs many of the products of the United States, and a great trade will be built up by the much talked of railroad through the three Americas." Gen. Bolet Peraza, of Venezuela, said: "Our trip has shown that all previous opinions regarding blood and language being barriers to perfect understanding between nations are wrong."

The Mexican minister, Senor Romero, said: "I think the international railroad a more feasible scheme than is generally believed, and that it will be begun in earnest before long. I expect before I die to go by rail from the city of Mexico to Buenos Ayres."

Senor Jacento Castellanos, from Salvador, said: "The opening of the Nicaragua canal will be a great boon to my country. Salvador trades with Europe only because of cheaper freights and longer credits."

Senor Zalaya, from Honduras, said: "We are doing what we can to add our link to the great chain of railways that will some day gird the two continents."

Dr. Guzman, from Nicaragua, believed that the trade of his country with the United States "would increase one hundred per cent as soon as the people learn how well and cheaply this country produces what they want."

Such American goods as they have seen have impressed them favorably. The best proof of this is to be found in the large sale of European goods bearing counterfeits of American trade marks. It may be said that even with the disadvantages we suffer under, because of lack of transportation facilities, the South Americans get their locomotives in the United States.

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In a recent dispatch to his government, Sir George Wyndham, British minister to Brazil, complained of this preference, saying that out of 252 locomotives in use upon the 18 railroads of Brazil, 213 came from the United States, and only 28 from Great Britain.

The trade by sea, under the present conditions of the carrying trade, offers for our merchants little hope, the South American commission appointed in 1884 to inquire into this matter, after taking the testimony of hundreds of merchants of the three continents, concluding that "it is impracticable to attempt to extend our trade in Central and South America as long as the transportation facilities are under the control of our rivals, and the few steamship lines between New York and Latin-American ports must compete with the heavily subsidized vessels of Europe."

Now, however, come fairer prospects and from a new direction. The project of an international railroad that shall traverse South and Central America, and, by joining the road about to be built in southeastern Mexico, reach a connecting link with the great railroad chain of the United States, has until a recent date been regarded as belonging to that class of projects known as visionary. Recent years, however, have seen great changes in South America. That famous American, Henry Meigs, started the railroad fever in South America. Above all his works stands the remarkable piece of engineering, the railroad from Mollendo on the Peruvian coast to La Paz, which when completed in 1871 opened up the interior of that country. It is only 100 miles long, but built along the rugged sides of the Cordilleras. Since that time railroads have multiplied; states have been joined by rail, the one with the other, till now [see map] there are innumerable links which only require piecing to form an important part of the great chain of railroads which will traverse two continents.

The Argentine Republic is growing at a really remarkable rate; Buenos Ayres, its capital, having a population of nearly half a million. In 1888 it had a foreign commerce of $280,690,000, of which $172,410,000 represented imports, including $44,000,000 coin, and $108,280,000 exports. Its demands for supplies for the construction of railroads, which, in 1887, were only $3,500,000, rose in 1888 to $13,600,000. Of agricultural products it exported in 1887 $21,257,320, against only $8,341,336 the previous year.

Within the past three years railroads have been actually built and routes surveyed for quite one-third of the distance between Buenos Ayres in the Argentine Republic and Bogota in the United States of Colombia (New Grenada) and close upon the Isthmus of Panama. A principal design is to build the major portion of this railway along the ancient Inca road which leaves the coast in the latitude of Santa Rosa in Peru and makes a short cut in the direction of Bogota.

Five several routes, each having its advantages from a mercantile or engineering standpoint, have lately been considered by South American capitalists. The most popular, because traversing the richest sections and heading all the principal rivers, tributaries of the mighty Amazon, is the following, which we take from a report made to the State Department by John E. Bacon, United States minister to Uruguay: First, the railroad from Buenos Ayres to Rosario, 186 miles; Rasario to Cordoba, 246 miles; Cordoba to Tucuman, 341 miles; Tucuman to Jujuy, 220 miles; total, 993 miles built and in operation. Then from Jujuy, almost on the Bolivian frontier, to La Paz, the capital of Bolivia, 500 miles; from La Paz to Santa Rosa, Bolivia, built, 220 miles; Santa Rosa to Cuzco, not built, 190 miles; Cuzco to Santa Rosa, Ecuador, not built, 880 miles; Santa Rosa to Hiradat, Colombia, not built, 450 miles; Hiradat to Bogota, built, 140 miles; total, 2,430 miles. This gives 993 miles in operation from Buenos Ayres to Jujuy, and 2,430 miles from Jujuy to Bogota, of which 360 miles are already built, leaving to be built 2,070 miles.

From the other end of the line, that is to say, from Mexico, there is great activity in railroad building. We learn from an authoritative source that British investments alone in railways in southeastern Mexico will, within six years, amount to $30,000,000. The Mexican Pacific Railway Co. recently sent a corps of engineers to begin surveys on that portion of the line running eastward from the Pacific port of Tonala. This road will connect the city of Mexico with Cordoba and Tuxtepec by a road now building, and open a line of rail communication with the Gautemalan frontier, and thence into the rest of Central America, money being already pledged in London for a road to the British colony of Belize.

From all this it will be seen by a study of the accompanying map, estimating that portion of Central America through which no railways are as yet projected at 1,000 miles, the entire length of road remaining to be projected in order to join the three Americas is only about 3,300 miles, or the distance between Boston and San Francisco.

It may be added that of the one-third of the great iron way between Buenos Ayres and Bogota referred to, most of it has been built within the last three years, including the worst section likely to be found on the whole line, to wit, between the Argentine Republic and Bolivia, the "Gran Chaco," and concessions are offered by all the states, not only of territory, but also from 5 to 7 per cent interest on all amounts invested in construction.

Visitors from the Milky Way.

As the number of recorded comets increases, and hardly a month passes nowadays without the discovery of one or more, inquiries into their origin become more interesting. Facts concerning the direction in which comets move when approaching and receding from the sun have recently been developed by Mr. W. H. S. Monck, which seem to connect the Milky Way with the origin of these strange wanderers of space. It appears that the axes of the orbits of the majority of the comets that have been seen are so situated with reference to the Galaxy as naturally to suggest that they have come to us from that great zone of stars.

The solitary situation of our sun with his attendant fleet of voyaging worlds is accentuated by these cometary visits. Where we are, within the circle of the Milky Way, space is comparatively deserted, an empty dungeon of immensity, through which the sun is speeding at the rate, say, of two hundred million miles in a year, moving from the southern toward the northern rim of the galactic spiral, but not exactly in its plane. In that spiral twenty million, fifty million, or it may be a hundred million, suns are crowded—nine-tenths of the visible creation. No mere human imagination can conceive a picture of their myriad activities, of the endlessly reduplicated blaze and energy of solar life in that metropolis of the universe. There are in the Milky Way suns of every order of magnitude, systems of stupendous extent and variety, and a maze of motions so wonderful, so complicated that mathematics is lost in them. All the forces of nature—physical, chemical, electrical—that are displayed upon the earth and in the sun are but as a drop of water in the ocean to the outpouring of those forces within the broad sweep of the Galaxy. Alone with our orb of day we dwell afar off from the splendid places, the populous centers, the great foci of creation.

We cannot even measure the distance to the nearest spiral of those congregated stars. We see other suns assembled in vast systems that move together through space, but it is doubtful whether ours belongs to any such system at all. If we reach out into the profundity of space beyond our little planetary system, it is twenty millions of millions of miles to the nearest shore, a mere speck like ours, in one direction, and forty millions of millions of miles in the opposite direction, while all around these far-off islands of space the distances are so vast, the deeps so profound, that no plummet of the intellect, no theodolite of the mind, can touch the bottom nor measure the height and the breadth.

Yet as the sun sails on, lighting the way for his planets through this ancient dungeon of space, visitors come to him, which show that after all he is not entirely alone in the interstellar desert. These visitors are comets. Many of them having once fallen within the overpowering attraction of the sun and entered his planetary precincts remain permanent members of his family, though making, in some cases, excursions far beyond the limits of the most distant planet's orbit. Others, perhaps, simply visit the sun, retaining sufficient independent motion after their perihelion passage to recede into space along parabolic or hyperbolic curves.

If the suggestion based on Mr. Monck's researches, that more comets come to us from the Milky Way than from other parts of the sky, is supported by future observations, it will tend to strengthen the view that comets—and consequently meteors, for the two are intimately connected—are the products of solar or stellar eruptions. There are a few cases on record of violent uprushes from the surface of the sun in which the measured velocity of the ejected matter was great enough, supposing it to have possessed a sufficient degree of solidity, to cast it far out in space, where, escaping from the control of the sun, it could wander on until it fell within the attraction of another sun, and so became a comet. There are many mightier suns than ours in the Milky Way, and if this theory of the origin of comets is correct, then it would be only natural to expect that the sun, in its voyage through space, should encounter more comets coming from the direction of the Galaxy than from any other quarter of the heavens.

How wonderfully the interest with which we regard the appearance of a comet in our sky is heightened when we can look upon it as, in a certain sense, a messenger come from those bright regions where the suns that light the universe are gathered thickest, and all the potentialities of existence flourish most abundantly. Astronomers have asserted that certain pieces of meteoric iron that have fallen upon the earth can be identified as fragments of known comets that have disintegrated into swarms of meteors. What is this, then, that we are told? That we can lay our hands upon a chunk of iron whose atoms once glowed in a star of the Milky Way! Marvelous is the universe. Wonderful is science.—*New York Sun.*

An Exhibition Car.

A few days ago an exhibition car of the Canadian Pacific Railway Company was in Toronto, the intention being to take it to a number of desirable points in Canada, and afterward on a tour through Michigan, Wisconsin, and Minnesota. It is richly stored with specimens of the agricultural and mineral wealth of the great Canadian Northwest, including British Columbia. The external appearance of the car is very attractive, and inside the arrangement is quite artistic. Over the door at one end is the great head of a bison, facing at the other extremity the head of a boar. All descriptions of magnificent straw, dried grasses, etc., disposed of to the greatest advantage in respect to display, cover the sides and the roof of the car, and make a most effective decoration. There may be seen the red fife straw, white fife, white Russian, Azoff Ladoga, Quebanca, and other varieties grown along the line of the C. P. R. from Winnipeg to Calgary, and along the southwestern branch. There are about thirty magnificent varieties in oats, including white Norway, black Tartarian, and white Russian. There are fifty-eight varieties of native grasses, besides cultivated grasses, such as English timothy. To get an idea of the luxuriant growth of these, one requires to see them. Many of them, even in their dried condition, are very beautiful, but their nutritious qualities are most regarded.

The car is divided into four sections—Assiniboia, Alberta, Manitoba, and British Columbia. Each district, in respect to grain cultivation, is represented by a hundred samples. Wheat, barley, oats, peas, vetches, and other products shown are all of the finest quality. There are specimens of the two, four, and six rowed barley, and what is a novelty, even among farmers, black barley, of which there is a splendid sample. There are seventy-two varieties of British Columbia fruit, besides vegetable marrows, turnips, and potatoes, and the Pacific coast province also is represented by twenty-three samples of natural grasses, samples of cedar and pine wood, and a maple leaf frame in a glass case which measures—the leaf, not the frame—21½ inches in diameter. Among the other exhibits are minerals in silver and gold quartz from the north shore of Lake Superior; coal from Anthracites, 85 miles west of Calgary; red sandstone from Lake Superior, and bricks from Vancouver and Banff. Hung round the sides of the car are views of British Columbia and the Northwest, and to represent borders between the sides and roof are strings of rare mosses and artificial flowers colored to show the dyes in the forest leaves.—*Canadian Manufacturer.*

Draught of Vehicles.

In a paper read before the British Association by Mr. T. H. Brigg, he described a new arrangement for traction which he had devised. The author contends that the present method of attachment of horses to vehicles is bad, as it robs the horse of much of its power; owing to the varying nature of the obstacles to be overcome by the wheels, either on the level or an incline, the correct line of draught is ever varying. The present mode of attaching horses causes the animal to exert an unreasonable amount of force by its hind quarters, particularly when the draught is heavy. In support of his theory the author quotes Professors Unwin and Kennedy. The former had said that supposing a horse weighs 12 cwt., divided between 6 cwt. on the fore and 6 cwt. on the hind quarters, the effect of a horizontal pull of 5 cwt. would be to reduce the forward weight to 2·7 cwt. and to increase the weight on the hind legs to 9·3 cwt., whereas with an inclination of trace equal to 30° the horse retained 5·1 cwt. on the fore legs and 9·1 cwt. on the hind legs, an increased weight of 2·2 cwt. due to the inclination of the trace. By the author's arrangement the attachment is so constructed that there is a vertical thrust put on the fore quarters equal to and counteracting the lifting tendency of the trace, so that the work done is distributed upon all four legs.

Cost of the Paris Exposition.

Many strangers have been speculating on the cost of the Paris exposition. It amounts to $7,600,000; but when to this is added the various amounts expended by the French ministerial department from the funds placed at their disposal for the purpose of entertaining foreign guests and for other incidental outlays, and those by foreign governments and individual exhibitions, the total, according to a rough estimate of the department of public works, cannot fall far short of $30,000,000. The expense of the glittering exhibition on the Champs de Mars in money was large, and so was its cost in life and limb. It is calculated that during the construction 6,530 men were treated for injuries or for illness resulting from exposure; 300 workmen hurt their legs, 260 received severe injuries to their eyes from projecting timbers or bars of iron; 114 were scalded or severely burned, and 50 had their fingers cut off. The deaths from falls are put down at the modest figure of 24; but it is believed that they were far more numerous, and the correct number was not given by the promotors of the exhibition.

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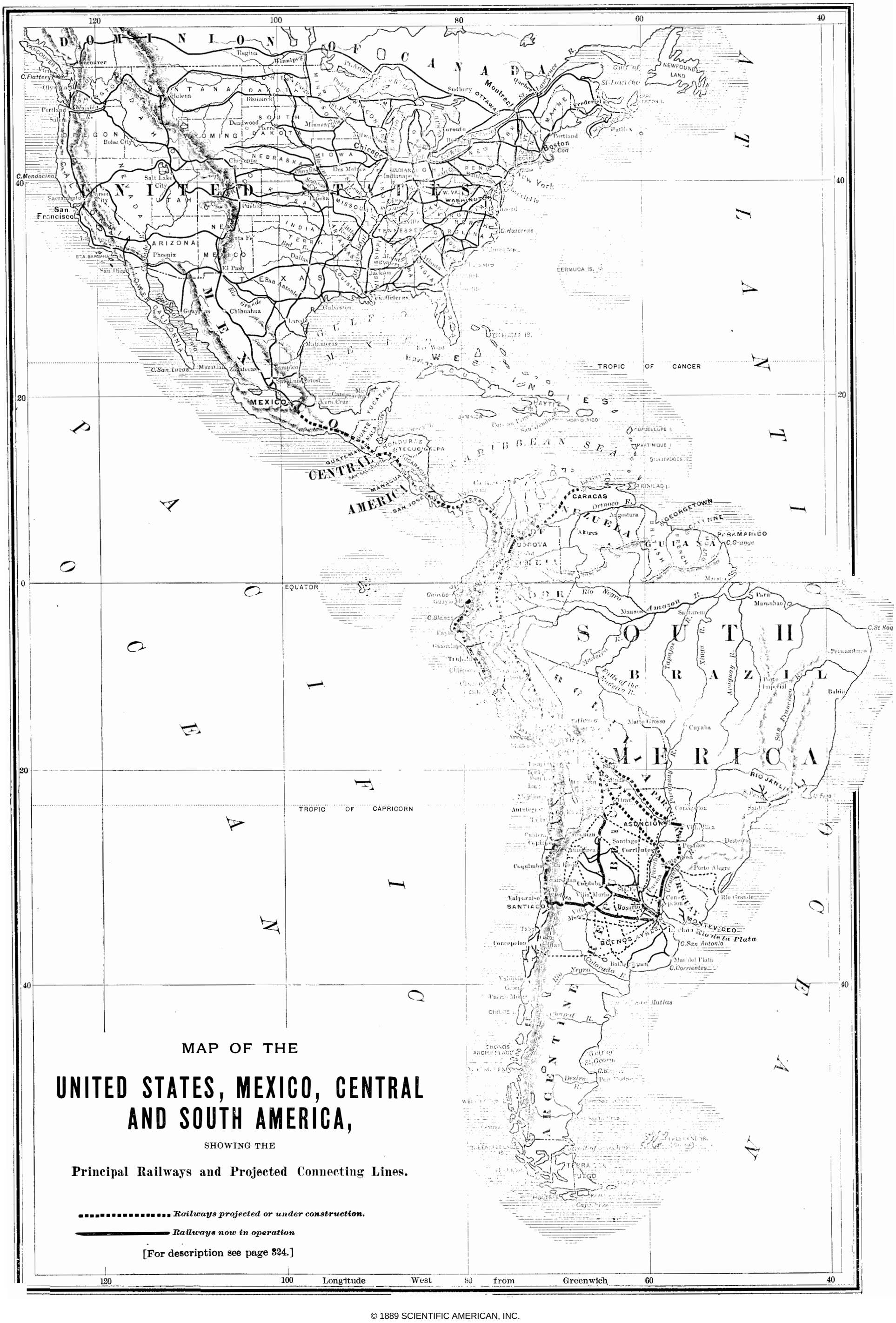

MAP OF THE

UNITED STATES, MEXICO, CENTRAL AND SOUTH AMERICA,

SHOWING THE

Principal Railways and Projected Connecting Lines.

Railways projected or under construction.

Railways now in operation

[For description see page 324.]

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GIRARD'S SLIDING RAILWAY.

Of the few really original mechanical novelties shown at the exposition, one of the most curious and interesting was undoubtedly the sliding railway operated there. Traction by sliding upon a fluid or a liquid like air or water is accompanied with a very small amount of friction, and effects a considerable saving in the effort developed as compared with that developed in rolling. Friction upon air would be almost insignificant, and upon water it is still less than in the rolling of metallic surfaces in contact.

We should, therefore, have here a means of greatly reducing the frictional efforts uselessly developed in the usual traction upon railways; and it will be readily understood why distinguished engineers like Mr. Girard and Mr. Barre have so ardently clung to the idea, despite the difficulties of all kinds that accompany the necessity of continuously interposing a fluid or liquid material and of preventing all metallic contact upon a line of great length.

Mr. Girard, who made the first studies of the sliding railway, had in view at the outset, in 1852, the direct application of water to traction upon railways, in order to replace the locomotive on mountain lines.

It will be seen, in fact, that, upon somewhat steep inclines, the locomotive rapidly loses all its useful effect, for the stress that it is capable of developing no longer serves for anything but to carry it along by its adhesion, and it can no longer haul anything but insignificant loads. Inventors have therefore endeavored to complete this adhesion stress with the rack or to replace the locomotive with a stationary machine that secures traction through a cable. Finally, such machines can be actuated through the use of the waterfalls that are so numerous in mountainous countries, and Mr. Girard proposed to dispense even with these machines by making streams of water act directly upon the train. The water is led to the center of the track by a series of nozzles, equally spaced, which project it against a series of curved pallets fixed beneath the vehicles and which form a sort of rectilinear turbine extending the entire length of the train. The distance of the nozzles is always less than such

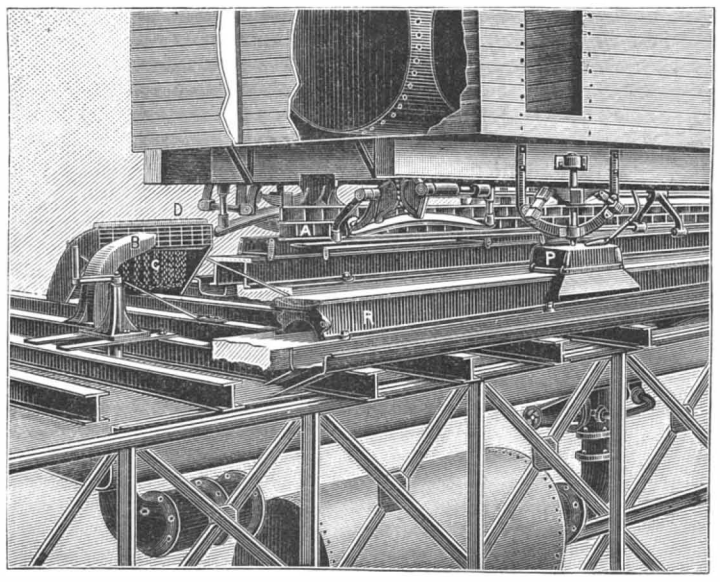

Fig. 2.—DETAILS OF THE MECHANISM.

P, slides. R, rail. A, pallets. B, nozzle.

length, so that the train remains continually submitted to the impulsion of the water under pressure, and cannot leave one nozzle behind until it has reached the one succeeding.

Starting from this, Mr. Girard had seen that there would be considerable saving in entirely suppressing rolling and in replacing the wheels of the vehicle with bearers sliding upon the rails, and interposing between the metallic surfaces a thin film of water, or even of air, if the thing were possible. A line according to these two principles was constructed by him, merely as a specimen, upon his estate at La Jonchere. The length was 40 meters and the gradient was a uniform one of 50 mm. to the meter. The line, under these limited conditions, worked satisfactorily. Despite this first success and the aid accorded him by Napoleon III., Mr. Girard could not obtain the concession of a long line that he had been soliciting for a long time in order to make a decisive test. Such a concession was not accorded him until 1869, this being for a line between Calais and Marseilles; but he died in 1871, a victim of war, without having been able to carry out the idea.

This idea of a sliding railway had about fallen into oblivion when it was taken up again by Mr. Barre,

M. GIRARD, INVENTOR OF THE SLIDING RAILWAY.

who had been Mr. Girard's colaborer, and who, after a few modifications in the original, constructed the experimental railway shown at the exposition of 1889.

This railway has a length of about 165 meters. The train consists of several open vehicles each provided with a line of pallets through which, by means of water projected against them by nozzles along the track, propulsion is effected.

Fig. 1 gives an external view of the sliding train, and Fig. 2 a detailed view that permits of a study of the main parts of the system, which are the bearer, the rail, and the propelling device.

The bearer of the vehicle, which forms the essential part, is represented at P, in Fig. 2, and again in detail in Fig. 3. It consists of a box having a depression in the center that forms a step that receives the weight of the car through the intermedium of a suspension rod. This step is as deep as possible without reaching the level of the friction guards. The object of this arrangement, devised by Mr. Barre, is to lower the center of suspension as much as possible and bring it below the center of thrust determined by the reaction of the compressed air in the interior of the box, and thus prevent overturning. The arrangement adopted by Mr. Girard did not give so satisfactory results, for the bearing point of the rod was much too far above the surface of friction, and the slide was wanting in stability. Let us add that the step has a spherical bearing surface with a sufficient play in the upper part to allow the slide to follow every possible inclination of the rail.

The water enters the box through the opening, S, in the cover. It accumulates therein under pressure and compresses the air, and the latter, being forced upward, tends to lift the bearer or slide which rests on the rail. The water then tends to escape through the whole extent of the perimeter, but the escape is interfered with by four concentric grooves with points of interruption formed in the guard of the slide. These grooves gradually lessen the velocity of the water, and a sufficient pressure is produced to lift the slide and vehicle, and thus allow a thin film (½ to ¾ mm.) of water to flow, and this prevents all contact between the guards and rails.

In the experiments made at Senlis, by Mr. Barre, a bearer supporting a total load of 1,060 kilogrammes, and supplied by a reservoir of water under a pressure of from 2 to 3 kilogrammes, discharged 140 liters of water in 2 minutes and 25 seconds, say 0·963 of a liter per second. The pressure of the air compressed under the slide kept constant at 1,800 kilogrammes, and the resistance to sliding during the running did not exceed ½ kilogramme. This, as may be seen, is scarcely a fifth of the resistance to rolling under the most favorable conditions.

The rails are in form like an inverted U, and are made wide so as to diminish the pressure supported per unit of surface. The slides are provided with shoulders that abut against the sides of the rail and prevent deviation during the running.

It is evidently necessary that the rail shall be placed in a well determined and invariable position in order to secure a perfect bearing of the slide, with the interposition of a constant thickness of water, and to prevent the contact of the metallic surfaces in all positions. This is perhaps the most difficult condition to fulfill upon a line of some length, which will necessarily present changes of level.

The joints, too, form a great difficulty by reason of the necessity of securing a tight continuity of the successive rails, and that, too, despite the expansions and the changes of level that always occur at such points under the influence of the movable load.

Mr. Girard provided for this in a very ingenious

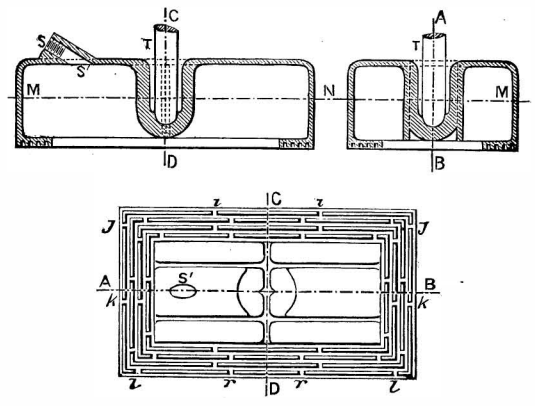

Fig. 3.—DETAILS OF SLIDES.

S, S', orifice through which the water enters the box. T, suspension rod. *i*, *j*, *k*, *l*, *r*, points of interruption in the channels of the guard. M, N, longitudinal and transverse sections of the slide.

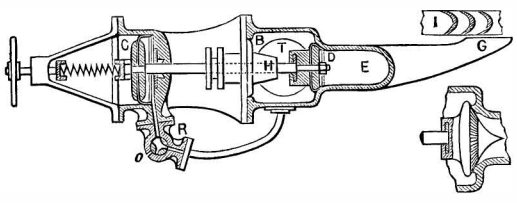

Fig. 4.—THEORETICAL LONGITUDINAL SECTION OF A PROPELLING APPARATUS.

D, stop valve. C, leather diaphragm for counterbalancing the pressure of the water on the valve. H, valve rod. G, orifice of the channel, E. R, maneuvering cock. O, orifice for regulating the escape of water.

manner by using rails with beveled ends, between which he interposed a wedge-shaped piece which was held in place by a spring that allowed it to slide freely with the expansion of the rails.

Mr. Barre has replaced this somewhat complicated joint with a more economical arrangement. The ends of the rails are provided with a curved groove which receives a rubber fillet that has enough elasticity to allow for the variations in the length of the rail due to changes in temperature. The rails are secured together by bolts passing through the flanges.

We must now speak of the propelling mechanism, which completes the installation of the railway. The water under pressure, directed through a main running the entire length of the road, flows, as we have said, into the stationary apparatus distributed along the route, whence it escapes upon the arrival of the train and exerts its

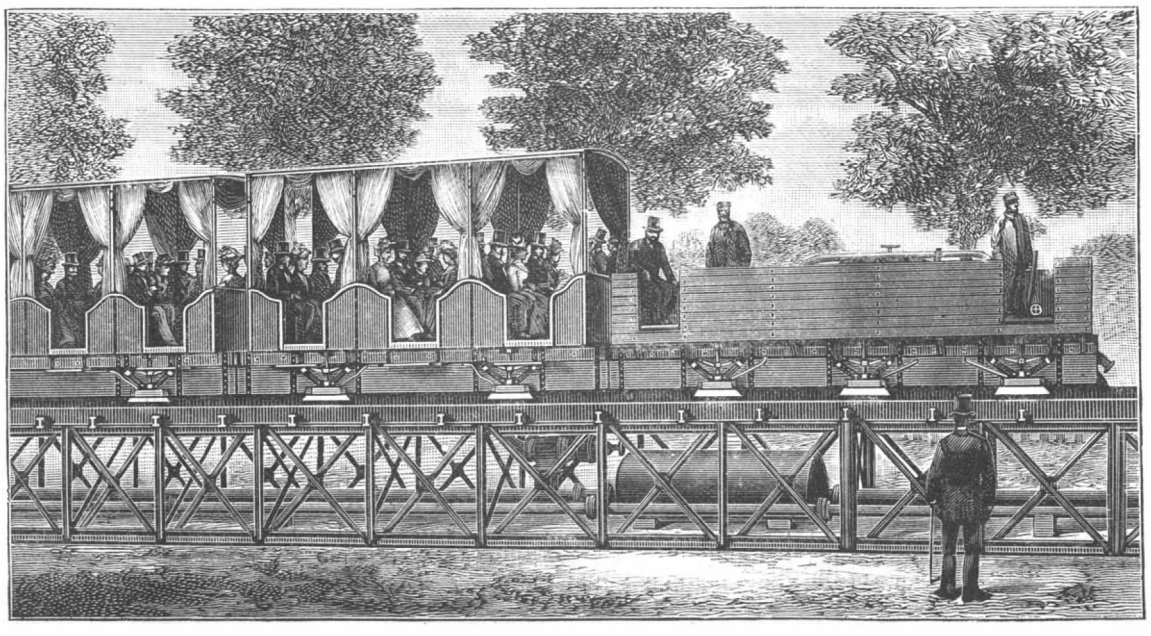

Fig. 1.—GIRARD'S SLIDING RAILWAY.

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impulse upon the pallets, and thus keeps up the motion. The water first enters a valve box fixed beneath the propeller.

This box, which is shown in detail in Fig. 4, is kept closed by the pressure of the water, and opens only under the action of a lever carried by the vehicle at the head of the train. The water then enters the propeller and spurts with force through the nozzle, B (Fig. 2). It thus meets the pallets, A, of the vehicle, which are opposite the nozzles. The flow of the water continues under such conditions until the admission valve in the propelling device is closed by another lever fixed upon the rear vehicle of the train. A special aperture in the cock permits of a graduated escape according to the successive positions that it occupies, and thus somewhat attenuates the shock to which the apparatus is submitted.

The nozzle of the propelling device is provided with an automatic valve to effect the emptying of the water in frosty weather when the propelling apparatus is not in operation.

The propelling apparatus are provided with special parts, D, which are fixed permanently upon the railway, and which are arranged opposite the apparatus with sufficient space for the passage of the pallets. They form a vertical channel of parabolic form which collects the water traversing the pallets, and, at the lower part, there are eight rows of pendent endless chains, C, designed to reduce the velocity of the water. They are carried along, in fact, in the stream issuing from the channel, and, becoming immersed in the mass of water, absorb its live force.

The water falls without velocity into a collector, whence it is taken to be used later on—the same water having always to be employed.

As for the water supply of the slides, that is furnished by the tender itself, which carries accumulators of compressed air serving to force the water under pressure into the slides. If the trips were very long, it would be necessary to have upon the tender a special machine for compressing the air.

It will be seen from this description how the system is set running. It suffices at the start to open the cock of the first propelling device by means of the lever on the forward car, and the motion afterward continues on the propelling apparatus being opened in succession through the front lever, while the lever in the rear closes them. If the train is to return upon the same track, it is necessary to have a second series of propelling apparatus acting upon a second line of pallets placed in an opposite direction and arranged under the cars alongside of the first. For starting, after a stoppage on the way, it requires a transmission throughout the length of the train permitting of actuating the cock of the proper propelling apparatus, whatever be its position with respect to the train.

In an exploitation on a large scale, questions quite difficult of solution would arise, such as regards switches, crossings, frost, etc. We do not believe there is any reason for paying much attention to these at present, for, however ingenious it be, the application of the sliding railway will probably remain for a long time limited to certain special cases upon lines of little extent. If, however, there were to be obtained a motor more independent of the track and that permitted of doing away with the water main, along with the propelling apparatus, as, for example, a motor actuated by electricity, this system would have greater elasticity and might doubtless become adapted to move varied appliances, especially upon elevated railways, for it does away with smoke, and secures a particularly agreeable mode of traveling for passengers. Finally, it is founded upon a very ingenious idea, and even an economical one from a theoretical point of view, and it would be a pity to see it remain unused forever.—*La Nature.*

Closing of the Paris Exposition.

On November 6, the closing of the Paris exposition of 1889 was celebrated by a magnificent *fete.* Beautiful weather contributed its part to the brilliant closing, and four hundred thousand people were in attendance. This was the greatest number ever present at once, and the exposition passes into history with great *eclat.* It now remains to be seen whether two years of work will achieve as great a success in America as over four years did in France. The great taste of the French nation was manifest in all departments and in every detail of the exposition. Among the many accounts published, criticism has been seldom found. From all sources the one judgment is to be formed to the effect that the exposition was in every way a success, and illustrated in all its parts the genius for organization that is so noticeable in the French race.

EVERY inventor, of course, should be protected in all his patented inventions. That is simple justice to the inventor. No invention should be allowed to cover what is not within its scope. That is simple justice to the public. Both inventors and the public are concerned in having all disputed patent cases promptly and authoritatively settled. That is simple justice to all.

The Eburneum Process.

As the name implies, the pictures partake of an ivory character; in fact, they were photographs, principally portraits, on an artificial ivory.

The process was first introduced by the late Mr. J. M. Burgess, of Norwich, somewhere about five-and-twenty years ago.

The process, as worked by Mr. Burgess, was this: A transparency by the wet collodion process was produced on glass, the plate, prior to coating with the collodion, being treated with wax to facilitate the subsequent removal of the film. In the development the image had to be kept exceedingly thin, while, as a matter of course, all the detail had to be secured. As a rule the pictures were vignetted portraits. After the picture, or, rather, pictures—for in practice several were usually made on the same plate to save trouble—were developed, fixed, and finished as transparencies, the plate was placed on a leveling stand, and the eburneum compound poured on. This consists of a solution of gelatine, with which was incorporated a white pigment—oxide of zinc being the one recommended by the inventor. To this mixture a small proportion of glycerine was also added, so as to prevent the gelatine becoming brittle when dry, and to secure flexibility. Sufficient of the compound was applied to the leveled plate to form, when dry, about the thickness of a thin mounting card. After the gelatine had set, the plate was reared up and allowed to dry spontaneously. When dry, the pictures were stripped from the glass and trimmed. They were then finished.

These pictures, when skillfully made, had all the appearance of being on ivory, such as that used by miniature painters, but without the objectionable grain.

The Eastman transferotype paper affords an excellent method of producing eburneum pictures of a high class. This method of making them would certainly commend itself to every one familiar with the working of bromine paper or the stripping films. The print is exposed in the ordinary way, but to obtain a warm tone a very full exposure should be given and the image brought out with a much diluted iron developer, keeping it somewhat thin, yet securing full detail. The picture is then transferred to collodionized glass plate, which has previously been talced, precisely in the same manner as when transferring a stripping film. The plate is then leveled, and the fluid eburneum poured on and allowed to set, and afterward dry. When the picture is then stripped off, it is finished; or, in the case of sheet eburneum or ivorine, it is simply softened in cold water and squeegeed upon the glass in the same manner as the gelatine skin is treated in the stripping film process for negatives.—*Br. Jour.*

Hints on Photographic Printing.

BY C. BRANGWIN BARNES.

Perhaps the knowledge of what to do in the way of dodging negatives may be of service to printers in general, though I do not for one moment intend to imply that in large businesses, where many hundreds of prints are turned out daily by one or two printers only, that each and every print can be dodged and doctored in the same way that every sitter has to be in the hands of the operator. But at any rate, any glaring inaccuracies in the negatives can be rectified, and that with the expenditure of very little extra time or trouble on the part of the printer. Negatives that are a little thin and lacking in pluck should never be laid down to face the light in the ordinary way; they should be stood on edge in the quietest light that can be found, and if the resulting print is not then sufficiently bright, fumed paper should be brought into requisition. A foggy negative, whether the fog be chemical or light fog, or caused by a misty atmosphere at the time of exposure, should always be printed on fumed paper. It is very little trouble to fume a few sheets of paper daily for use on special negatives, but the practice of so doing is, I am sorry to say, much rarer than it should be.

The paper to be fumed should be bone dry, and should be left in the fuming box for from ten to fifteen minutes; the strongest ammonia—liquid—should be used, and the sheet of paper fastened, face downward, to the lid of the box at least eighteen inches or two feet above the saucer containing the ammonia. It should then be hung up to dry, and for the free ammonia held by the paper to evaporate, which will take perhaps another fifteen minutes. The time and trouble will be much more than repaid by the increased beauty and brilliancy of the prints, and the printer who uses this dodge will find that his employer will grumble less at his work than heretofore. It is the privilege of employers to grumble at their assistants now and then, and it should be the aim of the assistants to give them as little cause for grumbling as possible.

Hard negatives, giving chalky prints, should be printed on weakly sensitized paper, or on paper that has been left on the bath too long, and when possible in the direct rays of the sun. If this does not have the desired effect, wash a sheet of sensitized paper, then redry it, and it will be found to print with much more harmony and considerably diminished contrast. Should, however, the contrast still be too great, the printer who is determined to succeed has still another loophole open to him; he can flash the print. By flashing the print I do not mean place it face upward in the light, and thus turn the whole of the whites into grays of a more or less muddy tint, but place it the other way about, that is face *down*, and print the reverse side of the paper; this will be found to slightly tinge the whites without damaging the other parts of the print, and can be carried to any extent, according to the harshness of the negative.

An under-exposed negative, in which the whites are not particularly harsh, but in which the blacks are so thin that to get the other parts sufficiently printed they all become merged in one sooty mass, requires a different treatment still. The negative should be covered on the reverse or glass side with tissue paper, and the white portions picked out, leaving the negative exposed in those parts only; it should then be printed on fumed paper, and if the blacks are still too deep, a second layer of tissue paper may be placed over the first and treated in the same manner. Negatives which have been covered with tissue paper should be printed in the quickest shade light obtainable. If a small portion of a negative be too thin, and print too black in comparison to the remainder, a wash of blue paint, Prussian blue, or indigo, should be lightly brushed over that portion, on the glass side.

Negatives in which white draperies occur—such as wedding dresses, infants' frocks, and so on—nearly always require a little doctoring before printing, or the drapery comes out very patchy and chalky. The tissue paper over the whole of the plate, with the draperies picked out, acts well in many cases, but occasionally this allows the white to print through too much, and represents a gray instead of a white. When such is the case, "papier minerale," which is more transparent than tissue, should be substituted, or in the absence of that, the negative—glass side, of course—should be coated with *plain* collodion which has been colored with Judson's dye, crimson preferably, though almost any color, with the exception of blue, may be used, and the collodion over the draperies should then be scraped away in the same manner as the tissue or minerale paper.

Cracked or broken negatives should always be printed through tissue paper and on a board suspended from a roasting jack, which same board should always be used for printing vignettes. Of course it is needless to add that the roasting jack should be kept in motion. Occasionally a reorder comes in for a negative in which the varnish is found to have cracked. This is best remedied by rubbing black lead powder, the scrapings from pencils, carefully into the cracks, when they will be found not to show at all, or at any rate very faintly, in the print.

Negatives with defective backgrounds, or which have become scratched or are very spotty, should in all cases be vignetted, so as to avoid much spotting.

Medals and decorations on the breasts of military men or court officials, even when treated with the greatest care by the operator, very rarely print out to show the design; the printer can, however, get over this difficulty with the aid of a hand magnifying or sun glass, taking care not to bring the focus exactly upon the plate, or the result will be disastrous. This same magnifying glass may often be used for other white patches, or what would be such without its aid.

Then as to landscapes and other out-door subjects with skies: no print should ever be turned out by a professional with a broad expanse of bald white paper where the sky ought to be. A few cloud negatives should be among the accessories of each and every printing room, and they should be in constant use. Some little judgment will be required in fitting the proper clouds to the proper subjects, but better slightly tone the paper, without putting any clouds, if that judgment be not used. This toning or tinting should be graduated, and the graduation may be either from the top to the horizon, or from the horizon to the top; some subject will be found better suited by the one, some by the other.

A device well worth knowing, and which should be in use in every photographic printing room, consists in putting a double thickness of sensitized paper on all dense, slow-printing negatives—the back piece may be any old spoiled print; and the object of this will be at once seen when tried, as the whites do not discolor, even after two or three days in the pressure frame.—*Photo. News.*

Guatemala Railroad Sold.

C. P. Huntington and C. F. Crocker have sold the road running from San Juan de Guatemala to Guatemala to the government of the state for $4,000,000. The road will now be extended, it is said, to Port Ysabel, on the Gulf coast, a distance of 250 miles, the capital for the enterprise having already been subscribed by a syndicate of French capitalists. Port Ysabel is only three days' distance by steam from New Orleans, and the new road is expected to open a large traffic between New Orleans, Guatemala, and San Francisco.

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Confectioner's Disease.

Dr. Rodiguez Mendez, Professor of Hygiene in the Medical Faculty of Barcelona, has just published in a new Spanish journal, *La Medicina Practica*, some notes of a case of a peculiar affection of the fingers and nails which appears to have been due to the patient's trade, that of a confectioner. Poncet, of Paris, and Albertin, of Lyons, have already observed the existence of this affection among those who are engaged in the calling of a confectioner. Dr. Mendez's patient was a man about forty years of age. When seen first every finger on both hands was affected, but not to the same extent. The worst was the middle finger of the right hand; here the anterior part of the nail was thickened and flattened, so that it had the appearance of a spatula, which is one of the signs noted by Albertin as occurring in his cases; the base of the nail was covered by a swollen portion of the soft parts which was not adherent to the nail, and which was of a bright red color, with fissures as well as ridges on its surface. In it there were a number of minute abscesses, from the openings of which little beads of pus could be made to exude by pressure. The disease was evidently a combination of onychia with paronychia, and it was a remarkable point in the history of the case that the man had suffered in a similar manner, only much less severely, some years before, when he first practiced the trade of a confectioner, and that when, for some cause totally unconnected with his malady, he had given up the trade, his fingers quite recovered. After a time he again took to the trade, but was at first engaged in making pastry and arranging the ornaments, during which time his fingers remained quite well. As soon, however, as he began to work on *marrons glacees* and on crystallized fruit, his fingers began to become sore just as they had done in former times. There could be no doubt that the affection was due to the immersion of the hands in hot and cold sirups and the rubbing in of sugar, which, according to Remy and Broca, has the property of causing the tissues to become gangrenous. Dr. Mendez suggests that in this way openings were made by which pyogenic micrococci obtained access. His treatment consisted in washing the parts with a boracic lotion and wrapping them in boracic cotton wool. Of course the patient was enjoined to discontinue working at his trade.—*Lancet.*

The Foreign Contract Law a Nullity.

Bradstreet's says of the matter: "It appears that the law as originally passed provided a punishment for persons who imported labor under contract, but made no disposition in relation to the laborers. The last Congress amended the law by inserting a provision for the return of laborers at the expense of the steamship company which brought them over, but it did not give jurisdiction in such cases to any court. The conclusion arrived at by the Treasury officials appears to be that if arrests are made under the law, a writ of *habeas corpus* will lie in each case, and that consequently laborers imported under contract can remain in the country without let or hindrance."

The act was passed as a concession by the politicians to the unreasoning labor element of the country. There was something praiseworthy, perhaps, in the purpose to try to keep out the hordes of ignorant foreigners who were brought here in a species of slavery from Italy and Hungary by contractors. But the law has not, in fact, excluded these people, while it has interfered with the coming hither of highly skilled laborers, and even of professional men. We have by no means all the skilled labor we want, and the man who is most wanted is a good workman who comes with a contract in his pocket which will put him at work as soon as he steps ashore. It is positively idiotic to shut out a man who is certain to support himself from the start, and to admit myriads of foreigners of whom there is no assurance that they will not be professional paupers before the year is out.

Progress of Electric Welding.

The Thomson Electric Welding Company, at their Lynn works, have within a few days been able to weld wire cable 1 5-16 inches in diameter for a cable to be used on a cable railroad, showing greater efficiency than was thought possible in doing this very difficult work. Although the strength of joints obtained by splicing was about thirty per cent that of the original cable, yet it was found from tests made at the Watertown arsenal of electric welds made of this cable that eighty-seven per cent of the efficiency of the rope itself had been obtained in these welds.

Correspondence.

A BOILER EXPLOSION AT BUCYRUS, OHIO.

To the Editor of the Scientific American:

I send herewith photograph of the boiler which exploded here at 2 o'clock A. M., October 14, 1889, killing three men instantly and doing much damage to the sorghum factory in which it was employed.

The boiler was an old-style two-flue, but well built and heavy, being made of $\frac{5}{16}$ inch iron, and weighing 4,800 pounds. It measures 18 feet in length and 4 feet in diameter.

The explosion was the result of pumping cold water into an almost empty and red hot boiler. This was done either through carelessness or ignorance on the part of the engineer, who paid for the fatal mistake with his own and two other valuable lives.

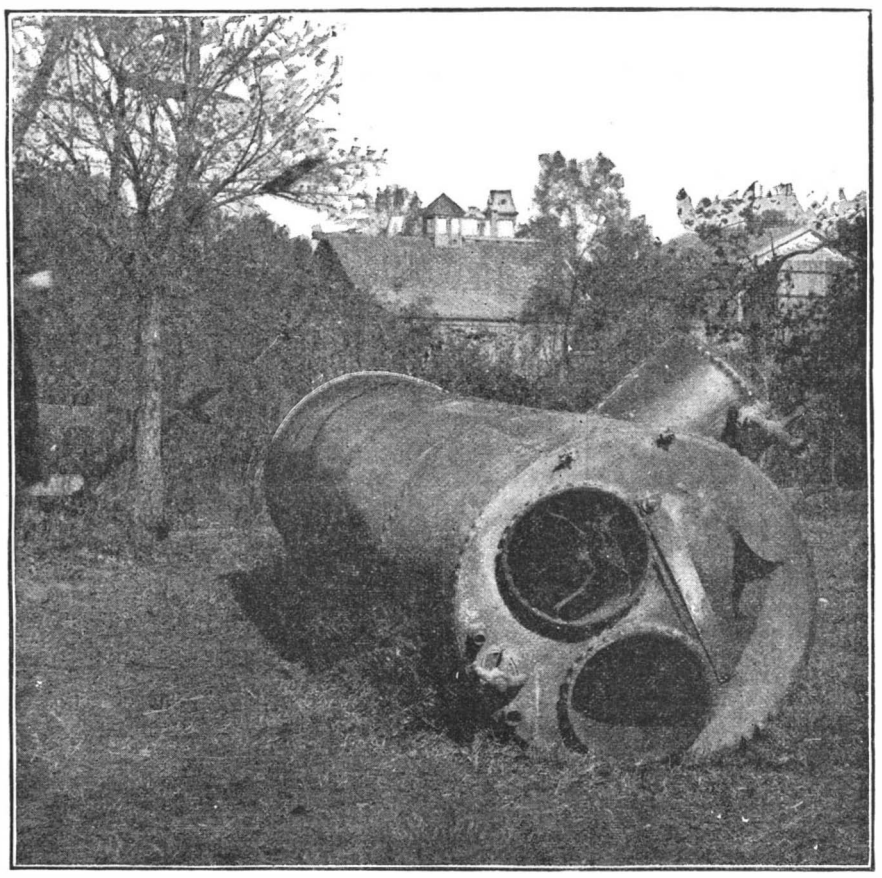
The exploded boiler shot from the works where it was stationed in a backward direction, passing through an 8 inch brick wall, which it utterly demolished, and scattering a mountain of *debris*, which was promiscuously piled to the rear of the building. The boiler then took a southerly course, passing high above the river bed, tearing a huge limb from a large sycamore on the south bank, and ultimately landing 100 feet south of the river, making an approximate distance from where it started of 500 feet.

A sycamore tree from which it tore the limb is 25 feet out of the direct line from the landing to the starting point of the boiler, showing that the boiler traveled in a curved direction. This is accounted for by engineers who have viewed the wreck. Owing to one end of one flue having been bursted, the propelling force was thrown to one side of the center, thus showing that the same force which propelled it also seemed to steer it.

This theory is reasonable, although it may not be correct. However, it is the duty of all those who study the SCIENTIFIC AMERICAN to try and advance a better one, and, if possible, explain the miraculous power of steam as manifested in this explosion.

J. J. FREY, M.E.

Bucyrus, Ohio, Oct. 18, 1889.



A BOILER EXPLOSION AT BUCYRUS, OHIO.

New African Gold Discoveries.

The San Francisco *Bulletin* says: "Recent accounts published of gold discoveries in the Transvaal Republic of South Africa go far to confirm the theory that the gold mines yet to be explored in South Africa may be as productive as those were in California or Australia. One town has sprung up, Johannesburg, on the edge of the gold fields, that now contains 40,000 inhabitants. The yield in six months of the present year of these mines has been $4,000,000. These mines are several hundred miles beyond the famous diamond mines of Kimberly. The latter mines are already connected with the seacoast by railroad.

"Miners are now flocking to the gold mines in the Transvaal Republic in great numbers. In all such mining excitements there is a great deal of fiction mixed up with the facts. But far beyond the Transvaal Republic in Mashuna-land there are reports of wonderful discoveries, surpassing in richness any heretofore known. The natives are extremely hostile to the whites, but the latter are pushing on to these mines. If the gold is there, it may be assumed that no native hostility will keep the miners out. The latest theory is that the real Ophir is in Mashuna-land. But it may be noted that Ophir is always moved along to the richest mines that are found. However, on the theory that Solomon procured his gold for the temple from the southwest coast of Africa, Ophir might as well be located in the mysterious Mashuna-land as elsewhere until the next famous discovery is made in Africa. Nothing of consequence has for some years been reported about gold in Central Africa. Vague accounts are given from time to time of natives who have both gold and ivory to exchange for goods.

"Africa, as a gold-bearing country, is virgin ground. The theory has long prevailed that it is the richest gold country of the world. This theory is partly supported by tradition and in part by such accounts as have been given from time to time by explorers."

The Panama Canal.

At the Panama bond drawing, October 15, the liquidator, M. Brunet, stated he was anxious to find a company which would complete the canal and take over the plant. A solid company would obviously not agree to do this until after full inquiry by independent and conscientious men. He had accordingly appointed an inquiry commission of unimpeachable honesty. An Englishman, a Dutchman, and a Belgian had been already selected to serve on it, but he had given up the idea of including an American, as there would be scarcely time for him to arrive. The French members comprise M. Guillemain, Director of the School of Bridges; M. Renoust des Orgeries, bridge inspector; M. Holtz, Professor of Navigation at the School of Bridges; M. Nivoit, Professor of Geology at the same place; M. Germain, Naval Hydrographer; M. Daymard, chief engineer of the Transatlantic Company; M. Lagout, bridge engineer; M. Chapert, chairman of the Venezuela Railway; and M. Du Chatenet, mining engineer. Two or three others would be added. Five would go to Panama in a month (December being the dry season) and make a thorough report on the works and on the best way of completing the canal in the time required—and also to obtain a renewal of the concession—and on the cost. No time must be lost, as the concession expires in three years, and would not be prolonged unless the works were in an advanced state. The commission has already held two sittings. If, contrary to his hopes, the capital could not be found in France, he should have to look elsewhere. He begged the share and bond holders for a few months' patience.

The Pullman Car Company.

The annual report of President Pullman, of Pullman's Palace Car Company, contains a great deal of matter of interest to the railroad and general public.

Briefly stated, it shows assets of approximately forty-one millions, with liabilities of twenty-six millions, leaving a surplus of about fifteen millions. The company is now supplying with sleepers 117,854 miles of the 160,000 miles of railroad in the United States, a gain of 11,723 miles during the year.

The total number of employes of the company is 11,063, and these employes received in wages nearly $6,000,000 during the year. In spite of the general dullness in car building throughout the United States, the population of the town of Pullman, where the principal shops are located, increased by 529 persons, while the average earnings of the 4,541 hands employed at Pullman, including men, boys, and a few women, averaged $50 per month.

A notable feature of the report is the information that there are 1,200 depositors at the Pullman Loan and Savings Bank, almost exclusively employes, and that the average amount to the credit of each is $235.82. Education and literature show marked progress at Pullman also.

Many, even of the friends of President Pullman, feared when the town was established it would not prove an entire success, but each year sustains the judgment of its founder and puts the pessimists to flight, by demonstrating by actual figures that the town is now an established success. We believe, says the *Railway Review*, the marvelous prosperity of this company is due in a large measure to the absolute control of its affairs by one head, the president.

THE paint factories of the Sherwin-Williams Company, a visit to which was noticed in our issue of Oct. 26, are located at Cleveland, O., and the company also has branch offices in New York and Chicago, and warehouses at Boston and San Francisco.

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RECENTLY PATENTED INVENTIONS.

Engineering.

STEAM ENGINE.—Robert H. Thurston, Ithaca, N. Y. This invention provides a non-conducting surface for the internal surfaces of the engine, such as the cylinder heads, the two sides of the piston, the internal surfaces of the ports and the clearance space, and a method of forming these surfaces integrally with the castings, to prevent the wasting of heat.

ROTARY ENGINE.—William P. Akers, Jacksborough, Texas. This invention covers an improvement designed to apply to engines with one, two, three, or more cylinders, and be simple and durable in construction, while using the steam expansively to the fullest advantage, at the same time being adapted to compound engines, the invention embracing various novel details and combinations of parts.

Railway Appliances.

GRIPPING DEVICE.—Aaron Twyman, Pullman, Ill. This is a gripping device carrier with attachments for cable railroad cars, the frame carrying the gripping device beam being provided with bars having a longitudinal slot or space adapted to receive slides carrying the beam, in order that the propelling power of the cable may be effectively communicated to the cars.

AUTOMATIC SIGNAL. — David Vinton, Jr., and Frank H. Vinton, Williamsburg, Mich. A revoluble signal is held on a post at the side of the track, in connection with a wheel or drum, levers, and a rod, cord, or wire connections leading each way, adapted for operation by trip devices actuated by passing trains, whereby the signal will be alternately shifted to danger and safety by trains moving along the track.

Agricultural.

PLOW.—John Clay, Sedalia, Mo. An upright is rigidly secured to the inner face of the share bar or land side, and the heel of the plow beam is pivoted to the under side of the share bar to the rear of the upright, a cleat of novel construction being provided whereby the beam may be held in any desired position by being locked to the upright, the beam being readily elevated or depressed as desired.

DRAUGHT EQUALIZER.—Jonas P. McDowell, Foote, Iowa. This is a device especially adapted for attachment to the tongues of harvesters, in connection with which three or more horses may be employed, the invention being an improvement on a former patented invention of the same inventor.

Miscellaneous.

BURGLAR ALARM. — Caleb C. Reid, New Burnside, Ill. Combined with a bell is a clock mechanism having on its escapement shaft a hammer and an arm, a pivoted trigger with hooked end being adapted to engage a pivoted arm, the trigger being operated by the opening of a door or window, the device being one which can be set to ring for a longer or shorter time as desired.

BOOT OR SHOE HEEL. — Ernest A. Munger, Beaver Dam, Wis. This heel is formed of two sections or plates, with a cushion interposed between them, connections extending between the plates and movably secured to one of them, projections on opposite sides entering the cushion, giving a vertical and a backward and forward yielding or spring, avoiding all shock and jar in walking.

SASH CORD GUIDE.—Abram S. Schellinger, Trenton, N. J. This invention provides a sheave case, a block, and a locking pin, so arranged that by inserting the pin between the case and the block and giving it a quarter turn the case will be locked to place, whereby the sheave case can be readily secured in place without special tools.

SHOW CASE. — Andrew B. Shipman, Columbus Junction, Iowa. This is a revolving show case more particularly designed for cigars and tobacco, and is polygonal in form, with a door in each panel, and has an alarm attachment applied to each door.

TRACE CARRIER. — Hiram Robison, Garwood, Pa. This is an apertured plate with upwardly projecting hook and socket above the hook, in combination with a tongue, for supporting the traces of a harness for convenience in harnessing, and also to prevent the trace from trailing when the horse is detached from the vehicle.

CEMENT SINK.—John Moore, East New Durham, N. J. This invention relates to the construction of wash tubs, sinks, etc., of cement, a metal skeleton or frame being used composed of a continuous metal cap strip arranged to form an outside protector to the rim to keep the cement from being chipped, an interwoven wire netting being embedded within the cement and serving to anchor the metal cap strip and stiffen the vessel.

KITCHEN CABINET. — John N. Ball, Kansas City, Kansas. In connection with this cabinet there is arranged an ironing board and attachments in such manner that when not in use they may be moved to a position out of the way, the space within the cabinet being available for the stowage of numerous articles.

GARMENT SUPPORT. — Clarence R. Arnold, Wellsville, Ohio. This is a device consisting principally of a holder, clasp, and sliding hinge connecting the clasp and holder, designed to effectually clamp a garment and support it without danger of tearing or otherwise injuring the material.

GAME ATTACHMENT FOR TABLES.—Joseph A. R. Studwell, Brooklyn, N. Y. This device consists of a plate or disk with radial arms projecting from its periphery, whereby the top of the table may be divided into a series of compartments for use as a game table and restored to its normal condition when desired, without marring the most highly polished surface.

WINDMILL. — Frank L. Butler, Concordia, Kansas. This windmill is designed to permit the wheel to run with great uniformity of speed in any wind, its construction being such that the operator can, by arrangement of a weight and adjusting the tension of a spring, regulate the vane in such a manner that the latter will cause the wheel to turn out of the wind whenever the wind increases above a certain velocity.

WIRE ROPE TRAMWAY. — George W. Pickett and Abel W. Pickering, Portland, Col. This tramway is for conveying coal, ores, or water from mines, and other similar uses, and is made by a novel arrangement of wire cables, buckets, and loading and dumping devices, to be capable of operating either by means of the weight of the material conveyed or by external power.

VALVE AND SPRAYING DEVICE.—Isaac H. Webb, Oil City, Pa. This invention covers an apparatus for cleaning the paraffine from the rock and walls of oil wells, and operates by spraying the fluid from the tubing on to the rock and walls of the well, the same apparatus being also adapted to steam the rock by making steam connections with the tubing.

TANK HEATER.—Joseph C. Goodrich, Grinnell, Iowa. This heater has a drum body adapted to fit upon the edges of the tank, the drum having a cap or cover with a smoke stack, and the fire pot is adapted to be removed bodily from the drum or heater body for replenishing the fire, the invention being an improvement on the ordinary form of patented tank heater.

SCIENTIFIC AMERICAN

BUILDING EDITION.

NOVEMBER NUMBER.—(No. 49.)

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

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(1513) W. H. R. writes: 1. In reading directions for photo-zinc etching it said, "After development, ink up the plate with a fine-grained roller charged with a stiff transfer ink." Of what composition is such a roller made? Does it mean a printer's roller? What is the formula for a "stiff transfer ink"? A. It is a leather-covered roller. The formulæ for successful printing inks are practically trade secrets. You should buy the ink of a reliable maker. 2. Give me the proper strength of an etching solution for photo-zinc etching. A. Use a three per cent acid solution. 3. Can I make plates ready for the press after they are etched, or do they require further manipulation? A. They are ready for use after etching, although they will stand retouching to almost any extent.

(1514) W. W. asks for information in regard to the manufacture of the enameled brick, especially how the enameled surface is obtained. Also for reference to literature on the subject, if there exists any such. A. Bricks are enameled by being dipped into a slip composed of finely ground enamel suspended in water. They are then dried and fired a second time. We refer you for brick making to "Brick and Tile Book," by Dobson, $2.50, and "Bricks, Tiles, and Terra Cotta," by Davis, $5.

(1515) A. L. H. writes: I notice by one of our papers that "bubble" parties are the rage in England; that the bubbles are made of oleate of soda and glycerine; and that they are very strong, will roll along the floor, and will last for days. I think there must be some ingredient in the receipt, as I cannot make the bubbles any stronger than with soap. Will you kindly look into the matter and advise through your valuable columns? A. In our SUPPLEMENT, No. 495, a number of receipts are given. All success depends on the purity of the soaps and glycerine, and a good mixture is very hard to make. In our SUPPLEMENT, No. 654, you will find further information on bubbles.

(1516) M. G. B.—36 feet 1 inch pipe or 27 feet 1¼ inch pipe will make a boiler of 1 h. p. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 702, for plans and description of small pipe boilers.

(1517) A. W. P. asks: 1. What are the agencies that cause granite to decay? A. Water and changes of temperature, and especially frost. 2. Is there any chemical or substance that would eat into granite, same as acid would in metal? A. No. The nearest approach would be hydrofluoric acid, which would attack it unevenly. 3. Is it possible to melt rock? A. Many kinds are fusible, melting to a more or less perfect glass.

(1518) E. R. asks: Can you inform me through your correspondence column of a simple and thoroughly effective method of making connection on carbon pole of Leclanche battery? The carbons I use are electric light pencils, and the connection corrodes. Don't want to have to drill holes in carbons if it can be helped. A. Heat the carbon rods at the ends only, and fill the pores with paraffin, then cast lead caps around the paraffined ends.

(1519) G. D.—You may anneal hard steel castings by heating in a slow fire to a full red heat, then cover up the fire with casting in it with ashes and allow the fire to die out. This may be done in the forge at night to good advantage. There is nothing better than salt water for hardening. Good steel and proper forging are necessary.

(1520) J. B. asks the simplest and most reliable way to test the quantity of lime in flint, the flint having been calcined and ground? A. Treat with hot muriatic acid, diluted with an equal volume of water, filter, wash, and weigh residue. The insoluble residue is flint.

(1521) S. T. W. asks: 1. Please mention a good balloon varnish, and receipt for same? A. The best is made by boiling down linseed oil as a body. Procure any first class article. Apply in successive coats. 2. In which paper have you published directions for building a canvas canoe? I wish to use common canvas for canoe. A. See SUPPLEMENT, No. 216. 3. What shall I use to make it waterproof? A. Paraffin applied hot to the perfectly dry canvas when in place is excellent. 4. In looking over an old number of the SCIENTIFIC AMERICAN, June 28, 1873, I found a receipt for making nitro-glycerine among the answers to correspondents. I tried it, using only a few drops, but had no success. The receipt was: Mix equal quantities of nitric and sulphuric acids, and add 1-6 their weight of glycerine. Where am I wrong? A. You may have made it without knowing it. See SUPPLEMENT, No. 243, for process of manufacture. 5. What book gives directions for making a gas balloon? A. You will find many articles on ballooning in our SUPPLEMENT. Unbleached cotton sheeting is a good basis, to be varnished until gas tight.

(1522) N. B. F. asks for a receipt for making a white ink such as card writers use for writing on a black card? A. Rub up Chinese white with solution of gum arabic. Settle the exact proportions by trial. For writing in white on blue paper, use a solution of oxalic acid (poison). This bleaches the paper and makes an indelible white mark.

(1523) S. J. O'B. asks: Are mica, steatite, or talc, and asbestos non-conductors of electricity? A. In the ordinary sense of the word they are non-conductors.

(1524) G. W. R. K. asks: 1. Can a ring bone on a colt be cured, and what is the treatment? A. Apply wet cloths for three days, removing at night. Then mix one drachm bin-iodide of mercury with one ounce of lard and rub one-half well into the affected part for ten minutes. Tie up the colt's head for a few hours, wash off with soap and water on the next day, and daily thereafter anoint the part with lard or oil for a week: then apply the rest of the ointment and repeat treatment as above. It may not yield to any remedies; you should consult a competent veterinary surgeon. 2. What is the test for finding copper or iron in rock? A. A mineral containing iron in any quantity becomes magnetic if powdered and heated in the reducing flame of the blowpipe on charcoal. Copper may be tested for with a borax bead; if a little powdered mineral is dissolved in it, and the bead is treated on charcoal with tin in the reducing flame of the blow-pipe it turns red and opaque, if copper is present. 3. Is copper or iron found in red rock like inclosed? A. It contains a little iron; probably no copper.

(1525) I. G. asks: Can you give me any information in regard to polishing platina? I find trouble in getting a good polish on same. A. Try scouring it with rotten stone, afterward polishing with whiting. Burnishing gives a good finish.

(1526) F. Z. writes: If I were to confine an explosive mixture of air and gas in a cylinder or sphere and heat it, at what temperature would it explode, due to the igniting of the mixture? A. The degree at which ignition would occur depends on the pressure. It would be at about a red heat.

(1527) F. J. D.—You are a little mixed in regard to the Eiffel tower resting with as light a weight at bottom as a man in an arm chair. Its whole weight rests solidly upon the four foundations. But there were hydraulic presses arranged, one within the base of each of the four legs, to adjust the vertical position of the tower in case of unequal settlement of the foundations.

(1528) W. H. F. — For storage battery see SCIENTIFIC AMERICAN, vol. 61, p. 22, and SUPPLEMENT, Nos. 322, 323, 517, 688.

(1529) C. A. T. W. — The samples are ferruginous clays, of no value except for brickmaking, etc.

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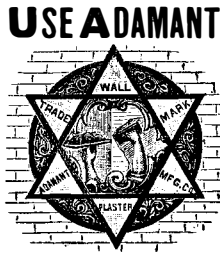

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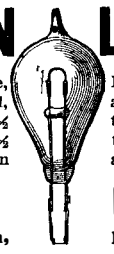

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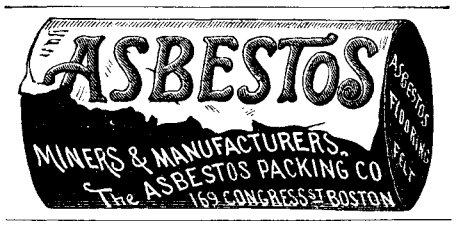

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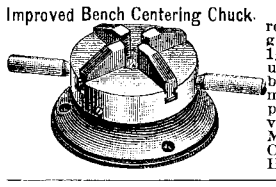

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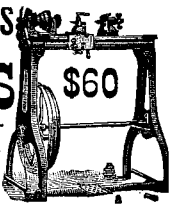

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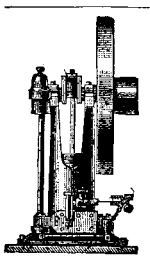

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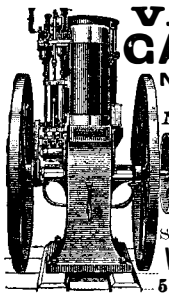

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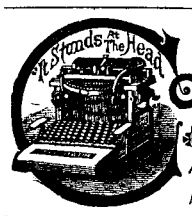

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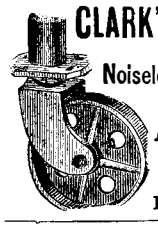

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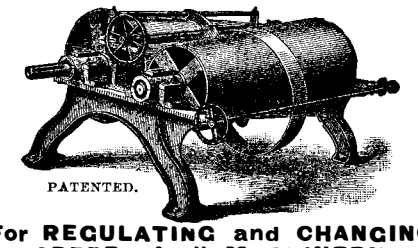

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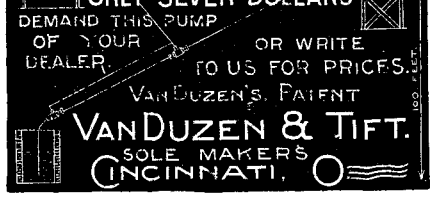

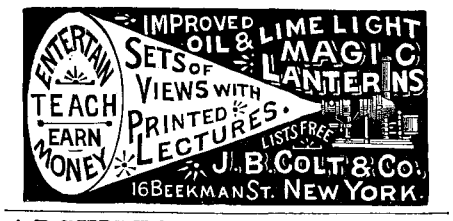

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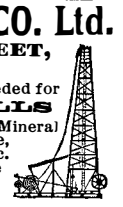

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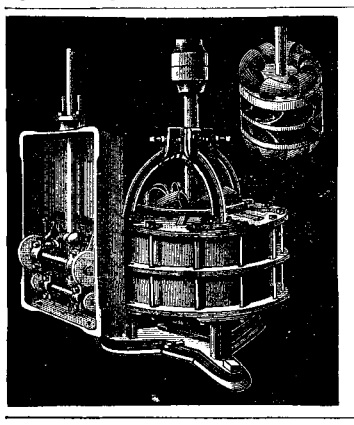

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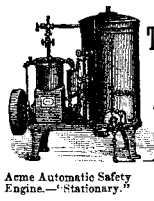

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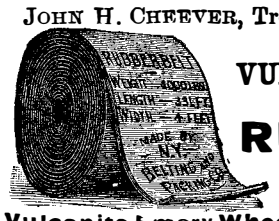

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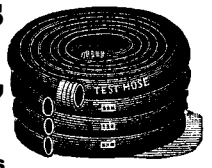

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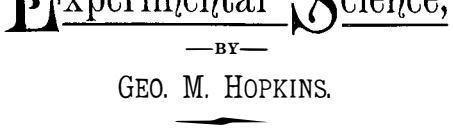

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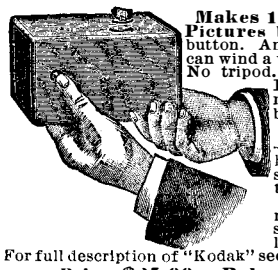

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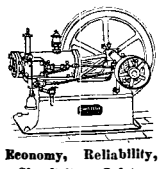

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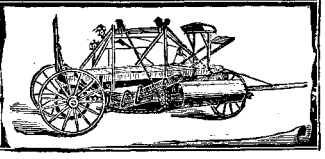

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